

Sampling and Analysis Plan

Yosemite Slough Sediment Waste Characterization Study

**Contract: EP-S5-08-01
TDD No.: TO-07-09-11-10-0001
Job No.: 002693.7008.01SO**

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Prepared for:

**U.S. ENVIRONMENTAL PROTECTION AGENCY
Region IX**

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Superfund Technical Assessment and Response Team

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January 9, 2012

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List of Abbreviations and Acronyms

bgs	below ground surface
CAM	California Assessment Manual
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	contaminant of potential concern
DDT	dichloro-diphenyl-trichloroethane
DQI	Data Quality Indicator
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
E & E	Ecology and Environment, Inc.
EE/CA	Engineering Evaluation and Cost Analysis
ERM	Effects Range Median
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
IDW	investigation-derived waste
LCS	laboratory control sample
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
mg/kg	milligrams per kilogram
NOAA	National Oceanic and Atmospheric Administration

List of Abbreviations and Acronyms (cont.)

PCBs	polychlorinated biphenyls
PE	Performance Evaluation
PM	Project Manager
ppb	parts per billion
ppm	parts per million
PPE	personal protective equipment
PQL	practical quantifiable limit
QA	Quality Assurance
QC	Quality Control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SFPUC	San Francisco Public Utilities Commission
SOP	standard operating procedure
START	Superfund Technical Assessment and Response Team
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TTLC	Total Threshold Limit Concentration, Title 26, California Code of Regulations
TPH	total petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
WCS	Waste Characterization Study

1

Introduction

In September 2011, the United States Environmental Protection Agency (U.S. EPA) Region IX Superfund Remedial Program Section directed the Ecology and Environment, Inc. Superfund Technical Assessment and Response Team (START) to support U.S. EPA's environmental data collection activities and a U.S. EPA-funded Engineering Evaluation and Cost Analysis (EE/CA) for a planned remediation of contaminated sediment in Yosemite Slough, San Francisco, San Francisco County, California. As part of the EE/CA process, it is necessary to estimate potential disposal costs that could be incurred during any future remedial action at Yosemite Slough. To help estimate these costs and support associated decision-making, the U.S. EPA tasked START to perform this Waste Characterization Study (WCS) of the impacted sediments at the Yosemite Slough Site. To support these activities, START has documented the project data quality objectives (DQOs) and this Sampling and Analysis Plan (SAP).

The Yosemite Slough Superfund Site (the Site) is an approximately 1,600-foot long channel that receives sewage and stormwater system overflows and stormwater runoff and leads to the South Basin of the San Francisco Bay. In addition, the Site area includes a portion of the South Basin at the mouth of Yosemite Slough, within the area designated as Parcel F of the U.S. Navy's Hunters Point Shipyard (see Figures 1 and 2), where impacted sediments from multiple sources may have been, or are, commingled. Analytical data from previous and on-going investigations of multiple sites in the vicinity of the study area indicate Site sediments are contaminated with polychlorinated biphenyls (PCBs); metals including chromium, lead, mercury, and zinc; total petroleum hydrocarbons (TPH); and the pesticides chlordane, dieldrin, and dichloro-diphenyl-trichloroethane (DDT), all at concentrations exceeding appropriate screening levels.

This SAP describes the project and data use objectives, data collection rationale, quality assurance goals, and requirements for sampling and analysis activities. It also defines the sampling and data collection methods that will be used for this project. This SAP is intended to accurately reflect the planned data-gathering activities for this support activity; however, Site conditions, budget, and

additional U.S. EPA direction may warrant modifications. All significant changes will be documented in site records.

The specific field sampling and chemical analysis information in this SAP was prepared in accordance with the following U.S. EPA documents: EPA Requirements for Quality Assurance Project Plans (EPA QA/R 5, March 2001, EPA/240/B 01/003); Guidance for the Data Quality Objectives Process (EPA QA/G 4, February 2006, EPA/240/R 02/009); Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA QA/G 5S, December 2002, EPA/240/R 02/005); and Uniform Federal Policy for Implementing Environmental Quality System (EPA/505/F-03/001, March 2005).

1.1 Project Organization

The following is a list of project personnel and their responsibilities:

U.S. EPA Remedial Project Manager (RPM) – The U.S. EPA RPM is Craig Cooper. Mr. Cooper is the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Additional duties include coordination of communication with the START Project Manager, U.S. EPA Quality Assurance (QA) Office, and U.S. EPA Region IX Laboratory, if applicable.

START Project Manager (PM) – Mr. Brian Milton is the START PM. The START PM manages the project's data collection efforts and is responsible for writing and implementing the SAP, coordinating project tasks and field sampling, managing field data, and completing all preliminary and final reporting.

Principal Data Users – Data generated during the implementation of this SAP will be utilized by the U.S. EPA RPM to make decisions regarding potential future actions at the Site.

START Quality Assurance (QA) Coordinator – Mr. Howard Edwards is the START QA Coordinator. Mr. Edwards will coordinate with the U.S. EPA's Quality Assurance Office as needed.

Sample Analysis and Laboratory Support – A START subcontracted laboratory and the U.S. EPA Region IX Laboratory (Region IX Lab) will be utilized for analysis of contaminants of potential concern (COPCs). The subcontracted laboratory is TestAmerica Laboratories, Inc., in West Sacramento, CA. Except for asbestos and hexavalent chromium, all samples will be analyzed by the region IX Lab.

1.2 Distribution List

Copies of the final SAP will be distributed to the following persons and organizations:

- Craig Cooper, U.S. EPA, Region IX
- E & E START Field Team
- E & E START project files

1.3 Statement of the Specific Problem

Previous sampling indicates elevated concentrations of PCBs, hydrocarbons, metals, and chlorinated pesticides are present in sediment at the Site. Due to the persistent nature of these COPCs in the environment and their potential toxicity to human health and the environment, a remedial action, which may include partial or complete removal of impacted sediments, will be conducted in coordination with a number of responsible parties and the U.S. EPA. To more accurately estimate the costs for disposal of sediments for remedial alternatives considered in the EE/CA, waste characterization data will be collected and used in the EE/CA evaluation to assess potential disposal options. Representative samples will be collected and used, along with historical data to estimate areas and volumes that could require different types of disposal (e.g., TSCA waste, RCRA waste, non-RCRA California hazardous waste and non-hazardous waste) if it were removed from the slough. This data can also be used to evaluate whether treatment of sediments could be required prior to offsite disposal. The COPCs for this waste characterization effort include asbestos, PCBs, and California Title 22 Metals (CAM-17). Because Yosemite Slough and the San Francisco Bay receive regional sediment which derives from naturally-occurring serpentinite deposits, some waste disposal facilities require asbestos characterization prior to accepting waste. Therefore, asbestos analysis is included in the laboratory suite.

2

Background

2.1 Site Location

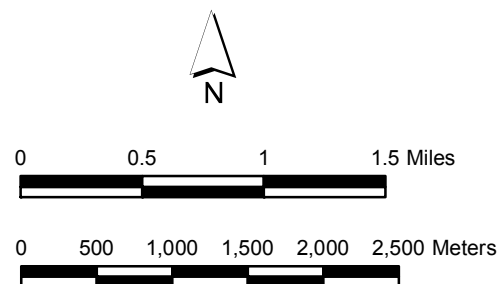
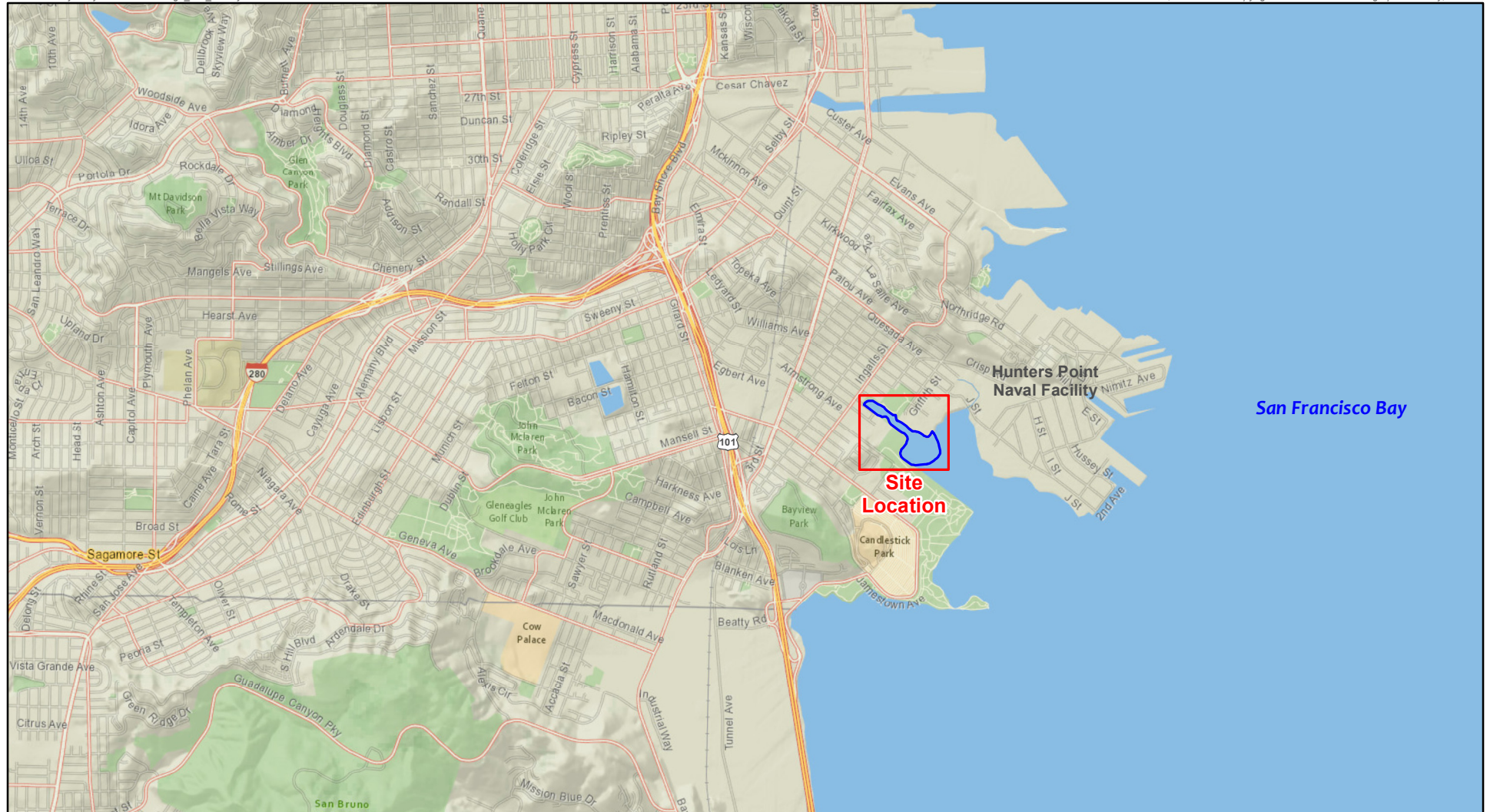
The Yosemite Slough Site includes a 1,600-foot long channel that leads to the South Basin of the San Francisco Bay in the southeastern portion of San Francisco, San Francisco County, California (Figures 1 and 2). In addition, the site includes a portion of South Basin at the mouth of the slough, within the area designated as Parcel F of the U.S. Navy's Hunters Point Shipyard, where impacted sediments from multiple sources may have been, or are, commingled. The approximate location of the Site is 37° 43' 25" North Latitude, 122° 23' 07" West Longitude. The exact boundary between the Yosemite Slough Site and impacted portions of Parcel F at the Hunters Point Shipyard Superfund Site and has not been determined.

2.2 Site Description

The Yosemite Slough drainage basin includes approximately 1,500 acres in southeastern San Francisco, California (Battelle 2004). The Yosemite slough Site, including the current study area, historically received sewage and stormwater overflows and stormwater runoff. Discharges of treated sewage and stormwater historically flowed from combined sewer and storm drain outfalls in and near the mouth of Yosemite Slough, to the southeast into the South Basin of the San Francisco Bay. The study area within the Site is approximately 1,800 feet long and varies from approximately 200 feet to 800 feet wide, with an area of 540,000 square feet. At low tide, the western (upgradient) portions of the Site are exposed; this exposed area and shallow submerged portions just outside the mouth of the slough, as depicted on Figure 2, will be the investigation area for this assessment.

2.3 Site History

Before 1900, the area around the Site consisted primarily of wetlands, marshland, or land submerged below mean tide level (intertidal and subtidal habitat). Between 1940 and 1970, much of the surrounding area was filled. The area surrounding the Site was characterized by mixed residential, commercial, and industrial use beginning in the 1950s.



Legend
 Approximate Site Boundary

Figure 1
Site Vicinity Map

Yosemite Creek
Sediment Removal
Assessment

San Francisco, California



Previous investigations have shown Site sediments to be impacted with PCBs; metals including chromium, lead, mercury, and zinc; TPH; and the pesticides chlordane, dieldrin, and DDT (Battelle 2004, E&E 2011).

2.4 Geology, Hydrology, and Hydrogeology

Based on information presented in the Battelle report (Battelle 2004) and documents from the nearby Bay Area Drum Site, the geology beneath the study area is expected to consist of artificial fill, younger bay mud, bay side sand, and/or Franciscan formation rock (sandstone, graywacke, shale, and chert) (Harding Lawson Associates [HLA] 1999). The closest available information regarding geology near the study area was obtained from the Hunters Point Shipyard Site. Geology beneath the adjacent Hunters Point Shipyard reportedly includes artificial fill, which can contain serpentinite bedrock, excavated bay mud, sands, gravels, and construction and industrial debris. The fill generally overlies bay mud deposits and occasionally undifferentiated sedimentary deposits (Barajas & Associates, Inc. 2008).

Groundwater flow in the region is towards the Site as a groundwater-to-surface water discharge into the South Basin (HLA 1999). The Yosemite Basin is located between two hills: to the north lies Hunters Point and to the south lies Bayview Hill. The original Yosemite Creek originated from a spring in what is now McLaren Park and flowed into San Francisco Bay. Yosemite Basin is approximately three square miles and is bounded by McLaren Park to the west and the Hunters Point Naval shipyard and San Francisco Bay to the east and northeast. Lands to the south and north of the site are owned by the California State Park system and managed as part of Candlestick Point State Recreation Area. This includes a recently constructed tidal wetlands project located on the north side of Yosemite Slough.

2.5 Stormwater and Sewer System Drainage

The San Francisco Public Utilities Commission (SFPUC) owned and operated the sewer system that has historically discharged to the study area under various configurations. Between 1959 and approximately 1991, SFPUC's combined sewer system operated with three overflow structures (outfalls 40, 41, and 42) that discharged to the study area during wet weather events, which occurred 82 times per year on average. Outfall 41, which drained much of the area east of Highway 101, was located at the mouth of the slough. Outfall 42 discharged at Fitch Street near the southern shoreline of the slough, draining areas that included industrial properties on the southern side of the study area and Candlestick Park. Outfall 40 discharged near Griffith Street on the north side of the slough and drained an area of approximately 200 acres, including the former Bay Area Drum Site.

In approximately 1991, SFPUC completed construction of overflow retention and storage basins for its combined sewer system. This upgrade has reduced the

number of system overflows to the Site to a long-term average of one per year (Battelle 2004).

2.6 Previous Investigations and Regulatory Involvement

The U.S. EPA, U.S. Department of the Navy and a significant number of other responsible parties have been working toward the selection of an appropriate remedial option for the Site, which has been determined to be affected by several source areas.

The South Basin area of the San Francisco Bay, which includes the Site, has been the subject of numerous environmental investigations (Battelle 2004). Remedial investigations, feasibility studies, and remedial actions are ongoing at the Hunters Point Shipyard Superfund Site, which includes the South Basin, under the U.S. Navy's Base Realignment and Closure Program. Additionally, the California State Parks Foundation conducted soil, groundwater, and sediment sampling for proposed wetlands creation areas in 35 acres including the Site. Sediments at the Site were investigated in December 1995 under the Bay Protection and Toxic Cleanup Program. Samples contained concentrations of mercury and PCBs exceeding the screening criteria (Battelle 2004).

As a part of ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial activities at Hunters Point Shipyard (see Figure 1), a remedial investigation and feasibility study was performed at Parcel F, the portion of Hunters Point Shipyard that includes the South Basin shoreline and adjacent sediments, by PRC Environmental Management, Inc. under the direction of the Navy in 1996. Sediment sample results in the South Basin and the Site indicated elevated levels of mercury, PCBs, DDT, and chlordane. This investigation was conducted to evaluate contamination of the South Basin by the Navy but also presented the potential for additional sources of contamination to the South Basin, including discharges to the Site (Battelle 2004).

Based on the evidence of contaminated sediments at the Site, the Regional Water Quality Control Board required further investigation to delineate the nature and extent of the contamination. Additional investigation and sampling of the Site was performed under the direction of the SFPUC in October 1998, October 1999, and April 2000. The SFPUC investigation included the collection of surface and subsurface sediment samples up to four feet below ground surface, as well as bioassays and bioaccumulation in clam tissue. The investigation and its results are discussed in the 2004 Battelle *Sediment Investigation at Yosemite Creek* report (Battelle 2004).

According to the Battelle report, the following COPCs are present at the Site at concentrations that exceeded their screening levels: lead, mercury, nickel, zinc, total PCBs, total DDT, total chlordane, and dieldrin. The maximum concentrations reported in surface sediments were: chromium at 202 parts per million (ppm), mercury at 1.21 ppm, nickel at 152 ppm, lead at 197 ppm, zinc at

2. Background

316 ppm, PCBs at 1317 parts per billion (ppb), total DDT at 142 ppb, total chlordane at 88 ppb, and dieldrin at 110 ppb. A total of 32 surface locations have been sampled by the SFPUC and the Navy in the vicinity of the Site.

Subsurface samples were collected at five locations during the 2004 Battelle investigation. Subsurface samples were collected to total depths of 4 feet below ground surface (bgs) in two locations, 3 feet bgs at one location, and 2 feet bgs at two locations. The maximum concentrations reported in subsurface sediments were: chromium at 368 ppm, lead at 811 ppm, mercury at 1.49 ppm, zinc at 830 ppm, dieldrin at 370 ppb, total chlordane at 208 ppb, total DDT at 1,430 ppb, and total PCBs at 2,356 ppb. These COPC concentrations exceeded their respective screening criteria, with the exception of chromium, and generally appeared to decrease with depth.

In addition to studies in the South Basin area discussed above, several environmental investigations have occurred at the former Bay Area Drum facility, a former drum recycling and reconditioning facility located north of the Site at 1212 Thomas Avenue in San Francisco, California.

Remediation of soil and groundwater at the former Bay Area Drum Site was completed in July 2003 under the direction of the California Department of Toxic Substances Control. The sewer and stormwater system draining the Bay Area Drum Site and its vicinity emptied into Yosemite Slough (Battelle 2004).

Between June 17 and July 9, 2009, START assisted USEPA with the collection of a total of 191 sediment samples from 36 sampling locations at the Site. Based on the results of the sediment sampling, PCBs (Aroclor-1254 and 1260 and PCB Congeners), metals (chromium, lead, mercury, and zinc), and TPH as diesel and motor oil were confirmed to be present in Yosemite Slough sediments at concentrations that exceed their respective environmental screening levels (ESLs). Elevated COPCs were predominantly located in the upper three feet of sediment at Yosemite Slough, although contaminant concentrations exceeding Site screening levels did occur in the 3-5 foot interval. PCBs, lead, mercury, zinc, and TPH-diesel contamination boundaries above Site screening levels were not completely defined during the 2009 assessment, including in the downstream direction towards the entrance to San Francisco Bay.

3

Project Objectives

3.1 Data Use Objectives

The data generated by implementing this SAP will be used to characterize the sediment from a waste disposal standpoint and evaluate the potential for extrapolating waste characteristics using existing data at the Site with respect to asbestos, PCBs and CAM-17 metals concentrations in sediment.

3.2 Project Task/Sampling Objectives

The U.S. EPA directed the START to prepare this SAP to support the environmental data collection activities necessary to support potential future actions at the Site.

Sediment sampling followed by laboratory analysis will be implemented to accomplish the project objectives. Sampling objectives include the following:

- Document the concentrations of PCBs, asbestos, and metals (chromium, lead, mercury, and zinc) in sediment at the Site and determine where these concentrations exceed state and federal waste disposal criteria.
- Using the WCS data and data sets from previous investigations, estimate the volume of sediment containing concentrations of asbestos, PCBs, and metals (chromium, lead, mercury, and zinc) that exceed state and federal waste disposal criteria by waste classification.

3.3 Action Levels

WCS evaluation criteria are based on readily-available, previously published criteria for the assessment waste disposal characteristics. The action levels for the primary COPCs are presented in Table 3-1, and a flow chart for the evaluation of Site data is presented as Figure 3. Action levels for metals and PCBs came from the following sources:

- California Code of Regulations (CCR) at Title 22 Social Security, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste.



3. *Project Objectives*

- U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Parts 260-299 (RCRA).
- Toxic Substances Control Act (TSCA). Title I - Control of Toxic Substances.

Because Yosemite Slough and the San Francisco Bay receive regional sediment which derives from naturally occurring serpentinite deposits, some waste disposal facilities may require asbestos characterization prior to accepting waste. Therefore, asbestos analysis is included in the laboratory suite. The State of California will classify the sediment as hazardous waste if it is determined to contain greater than 1% of friable asbestos; therefore, 1% (10,000 mg/kg) is the action level for asbestos.

3. Project Objectives

Table 3-1
Waste Characterization Study Action Levels
 Yosemite Slough Sediment Waste Characterization Study
 TDD No.: TO-02 09-11-09-0004
 Job No.: 002693.2693.01RF

Contaminants of Potential Concern	TCLP (mg/L)	STLC (mg/L)	TTLC (mg/kg)	Other Action Level (mg/kg)
Antimony	NA	15	500	NA
Arsenic	5.0	5.0	500	NA
Barium	100	100	10,000	NA
Beryllium	NA	0.75	75	NA
Cadmium	1.0	1.0	100	NA
Chromium (VI)	5.0	5.0	500	NA
Cobalt	NA	80	8,000	NA
Copper	NA	25	2,500	NA
Lead	5.0	5.0	1,000	NA
Mercury	0.2	0.2	20	NA
Molybdenum	NA	350	3,500	NA
Nickel	NA	20	2,000	NA
Selenium	1.0	1.0	100	NA
Silver	5.0	5.0	500	NA
Thallium	NA	7.0	700	NA
Vanadium	NA	24	2,400	NA
Zinc	NA	250	5,000	NA
PCBs	NA	5.0	50	Various ¹
Asbestos	NA	NA	NA	10,000

TCLP = Toxicity Characteristic Leaching Procedure, 40 CFR Part 261.
 STLC = Soluble Threshold Limit Concentration, Title 26, California Code of Regulations
 TTLC = Total Threshold Limit Concentration, Title 26, California Code of Regulations
 mg/L = milligrams per liter
 mg/kg = milligrams per kilogram
 NA = Not applicable

¹PCB data will be compared to TSCA PCB screening criteria in addition to CA and Federal disposal guidelines.

3. Project Objectives

3.4 Data Quality Objectives

The Data Quality Objectives (DQO) Process for the Yosemite Slough WCS is presented in Appendix A.

3.5 Schedule of Sampling Activities

The field sampling activities will be scheduled upon approval of the SAP by the U.S. EPA. Field sampling in the slough will occur in calm wind conditions at high tide when the Site is submerged under water, and may take up to two days depending on tide conditions, sample recovery, weather, and Site access.

3.6 Special Training Requirements/Certifications

Data validation requires specialized training and experience. A START chemist will likely complete the data validation.

Field sampling personnel should be trained and have experience with sediment sampling at hazardous waste sites while wearing respiratory protective equipment. One field sampler should be trained and familiar with Global Positioning System (GPS) data collection. All sampling personnel must have appropriate training that complies with 29 Code of Federal Regulations 1910.120. The site-specific health and safety plan for this project is appended to this plan (Appendix B).

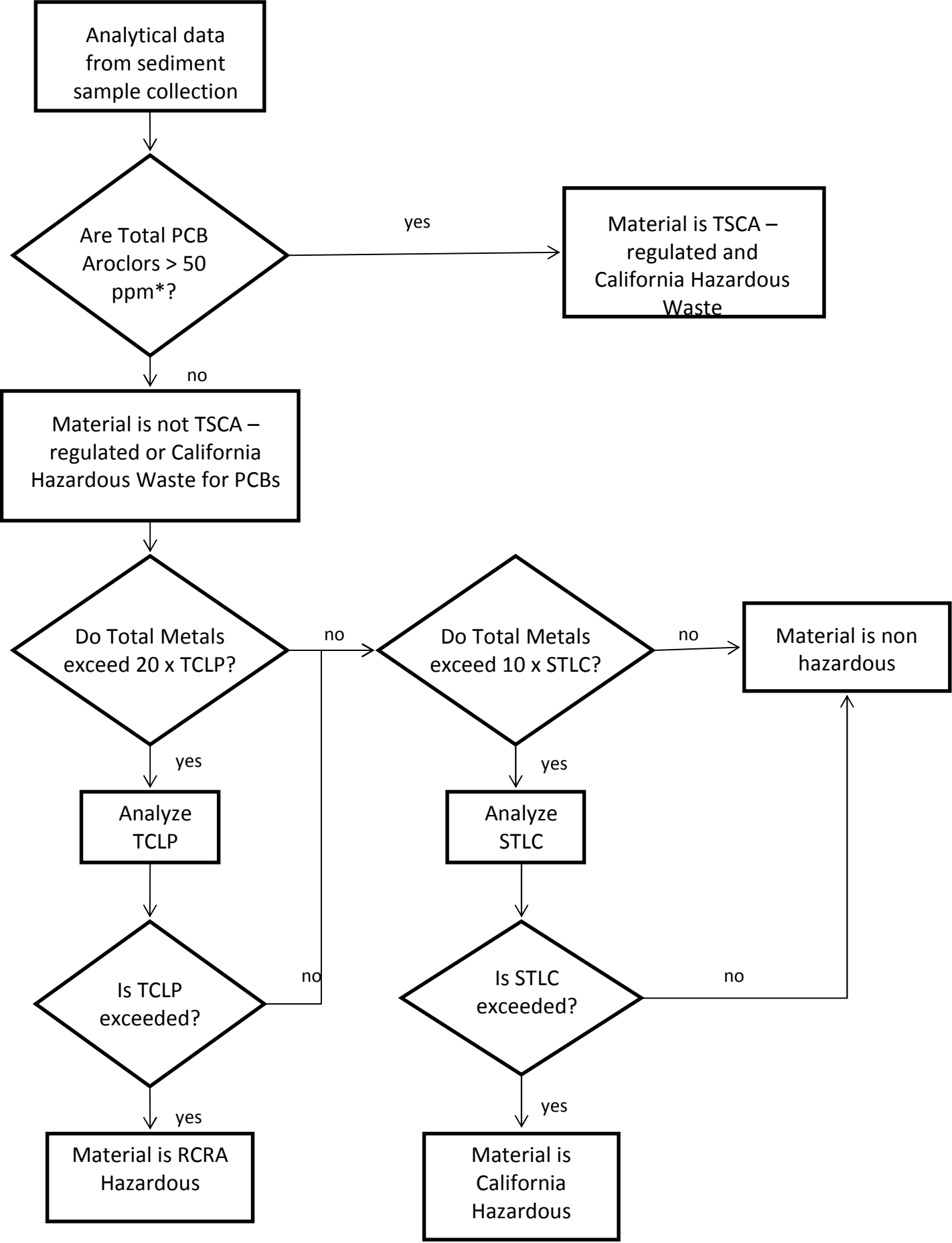


Figure 3– Decision Process for Screening Analytical Data; Yosemite Creek EE/CA Waste Characterization Study.

4

Sampling Rationale and Design

The START reviewed available Site information, including recent sampling data, and consulted with the U.S. EPA to determine the specific sampling locations as shown in Figure 4. To insure that the collected samples are at concentrations usable for establishing a correlation with historic data, the sampling locations will be selected based on previous analytical results in areas where there are documented contamination “hot spots”. The sediments in these areas are the most likely to have the hazardous waste characteristics needed to determine the correlation needed to support of the EE/CA evaluation in of remedial options.

4.1 Sampling Locations

Based on the area to be covered and the DQOs, sediment from eight sampling locations will be collected. At each location, four vertical samples will be collected for a total of 24 to 32 samples.

Most sample locations will be accessed during high tide, when the Site is submerged under water. Sample locations will be accessed by boat; Table 5-1 summarizes the samples to be collected. Additional samples may be identified and investigated as directed by the U.S. EPA.

4.2 Sample Depths and Collection

Samples will be collected at 1-foot intervals to a total depth of four feet. Four samples per location (0–1 feet bgs, 1–2 feet bgs, 2–3 feet bgs, and 3–4 feet bgs) will be collected. Samples will be homogenized in a stainless steel bowl and then placed into the appropriate sample containers using stainless steel sampling scoops. Sample collection methods will depend on the method selected for borehole advancement. Samples will be placed in the appropriate container for each analysis method. All samples will be placed in coolers and chilled with ice to 4° C for storage and shipping. The sediment samples will be analyzed for the COPCs as listed in Table 3-1.

4.3 Analytes of Concern

The primary analytes of concern are metals, PCBs, and asbestos. The metals and PCBs are confirmed to be present on Site above initial state and federal screening criteria, and waste characterization sampling is necessary for disposal consideration (see Figure 3). In addition, because Yosemite Slough and the San Francisco Bay receive regional sediment which derives from naturally-occurring serpentinite deposits, some waste disposal facilities require asbestos characterization prior to accepting waste. Therefore, asbestos analysis is included in the laboratory suite.



5

Analytical Testing

It is anticipated that up to 24-32 sediment samples, including 3 field duplicate samples, will be collected and sent to an analytical laboratory for testing. The specific laboratory analytical analyses are described below.

5.1 Laboratory Analysis

Sediment samples will be submitted to a laboratory for the following analyses:

- CAM-17 metals (EPA Method 6010B)
- Hexavalent Chromium (EPA Method 7196)
- Mercury (EPA Method 7471A)
- PCBs (EPA Method 8082)
- Asbestos by polarized light microscopy (PLM; EPA Method 600/R-93/116)

Additional or remainder sample volumes will be held at the laboratory pending the screening of preliminary analytical results for the purpose of conducting TCLP and California Assessment Manual (CAM) extractions and analysis, as appropriate.

An analytical laboratory has not been selected at the time of the writing of this SAP. The analytical laboratory will be procured prior to sampling, and a review of the laboratory will be conducted to ensure that the laboratory can perform the required analyses and meet the required reporting limits.

Sample containers, preservatives, holding times, and estimated number of field samples for sediment (including QA/QC sediment samples) are summarized in Table 5-1. QC aqueous samples are summarized in Table 5-2.

To provide analytical quality control for the analytical program, the following measures will be utilized:

- Additional sample volume will be collected for at least five percent of samples per each analytical method, to be utilized for matrix spike/matrix spike duplicate analysis.

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- Split duplicate samples will be collected from ten percent of the sampling locations that are submitted for sediment analysis. A duplicate split sample is a 50/50 split of a multi-incremental sample after collection.

A rinsate blank will be collected at a rate of one per day to evaluate decontamination procedures at the Site. The rinsate blank will be collected by pouring deionized water over the decontaminated sample collection device (e.g., bowl, slide hammer, shovel, gravity core sampler) and capturing the water in the specified sample container.

Table 5-1
Sampling and Analysis Summary - Sediment and QA/QC Sediment Samples
 Yosemite Slough Sediment Waste Characterization Study
 TDD No.: TO-07-09-11-10-0001
 Job No.: 002693.7008.01SO

Method	Metals (6010B)	Mercury (7471A)	Hexavalent chromium (7176A or equivalent method)	PCBs (8082)	Asbestos by PLM (600/R-93/116)
Minimum Volume*	5 grams	0.5 grams	2.5 grams	30 grams	10 grams
Sample Container	8-ounce glass or plastic jar		4-ounce glass or plastic jar	8-ounce glass jar	4-ounce glass jar
Preservation	0-4°C	0-4°C	0-4°C	0-4°C	None
Analysis Holding Time	6 months	28 days	24 hours	14 days from sample collection to extraction, then 40 days from extraction to analysis	None
Sampling Location	Number of Samples	Number of Samples	Number of Samples	Number of Samples	Number of Samples
YC-038 to YC-045	24-32	24-32	24-32	24-32	24-32
Duplicate Samples (10%)	3	3	3	3	3
MS/MSD (5%)	1	1	1	1	1
Total Number of Samples	28-36	28-36	28-36	28-36	28-36

Source: 2011 Ecology and Environment, Inc.

Notes:

QA/QC = Quality Assurance/Quality Control

PCBs = polychlorinated biphenyls

MS/MSD = Matrix Spike/Matrix Spike Duplicate – extra volume will be collected for analysis, but not considered a sample and not included in “total number of samples” calculation. Double soil volume will be collected for metals, PCBs, Asbestos.

* = Minimum Volume for determination of total concentrations. Leaching Procedure extractions require 300 to 400 grams of sample.

5. Analytical Testing

Table 5-2
QA/QC Sampling and Analysis Summary - Aqueous Samples
 Yosemite Slough Sediment Waste Characterization Study
 TDD No.: TO-07-09-11-10-0001
 Job No.: 002693.7008.01SO

Method	Metals (USEPA Method 6010B)	Hexavalent chromium (USEPA Method 7176A or equivalent method)	Mercury (USEPA Method 7470A)	PCBs (USEPA Method 8082)
Minimum Volume	100 mL	100 mL	100 mL	1 L
Sample Container	500 mL poly	500 mL poly	250 mL poly	1 L glass
Preservation	HNO ₃	HNO ₃	HNO ₃	0-4°C
Analysis Holding Time	6 months	24 hours	28 days	7 days from sample collection to extraction, then 40 days from extraction to analysis
Equipment Rinse Blank	1 per day	1 per day	1 per day	1 per day
Source: 2011 Ecology and Environment, Inc. Notes: QA/QC = Quality Assurance/Quality Control PCBs = polychlorinated biphenyls HNO ₃ = Nitric Acid mL = milliliters L = Liter Poly = polyethylene USEPA = United States Environmental Protection Agency				

6

Field Methods and Procedures

6.1 Field Procedures

The following sampling standard operating procedures (SOPs) or their equivalent will be used to guide the field procedures:

- Ecology and Environment Inc. SOP # ENV 3.8: Sediment Sampling
- Ecology and Environment Inc. SOP# ENV 3.15: Sampling Equipment Decontamination

Deviations from the SOPs will be documented in the field notes.

6.1.1 Equipment

The equipment listed in the next subsection may be utilized to obtain environmental samples. The START and U.S. EPA will determine which equipment to use in the field depending on Site conditions and other factors such as accessibility, sediment thickness, and geotechnical limitations.

6.1.1.1 Equipment Used

The following is a partial list of equipment that is anticipated to come in contact with sediment samples:

- Shovels, trowels, scoops
- Gravity core sampler or equivalent
- Stainless steel bowls or glass containers
- Stainless steel sampling scoops

6.1.1.2 Equipment Maintenance

Field instrumentation for the collection of sediment samples will be operated, calibrated, and maintained by the sampling team in accordance with the SOPs listed in Section 6.1 or their equivalent. Field instrumentation utilized for health and safety purposes will be operated, calibrated, and maintained by the sampling team according to manufacturers' instruction. Calibration and field use data will be recorded in the instrument log books.

6.1.1.3 Inspection/Acceptance Requirements for Supplies and Consumables

There are no project-specific inspection/acceptance criteria for supplies and consumables. It is standard operating procedure that personnel will not use broken or defective materials; items will not be used past their expiration date; supplies and consumables will be checked against order and packing slips to verify the correct items were received; and the supplier will be notified of any missing or damaged items.

6.1.2 Field Notes

Field notes are a daily requirement and will be kept by the START sample team in a Site logbook. Details are described in the next subsection.

6.1.2.1 Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, as applicable, during the collection of each sample:

- Sample location and description
- Site sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Type of sample (matrix)
- Type of sampling equipment used
- Onsite measurement data (e.g., temperature, pH, conductivity)
- Field observations and details important to analysis or integrity of samples (rain, odors, etc.)
- Type(s) of preservation used
- Instrument reading (water quality meter)
- Shipping arrangements (air bill numbers)
- Receiving laboratory(ies)

In addition to sampling information, the following specifics may also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival onsite and time of departure
- Other personnel onsite
- A summary of any meetings or discussions with any potentially responsible parties, or representatives of any federal, state, or other regulatory agency
- Deviations from sampling plans, site safety plans, and SAP procedures
- Changes in personnel and responsibilities as well as reasons for the change
- Levels of safety protection
- Calibration information for equipment used on Site
- Record of photographs

6.1.2.2 Photographs

Photographs will be taken at representative sampling locations and at other areas of interest onsite. They will serve to verify information entered in the field logbook. When a photograph is taken, the following information will be written in the logbook or will be recorded in a separate field photography log:

- Time, date, location, and, if appropriate, weather conditions
- Description of the subject photographed
- Name of person taking the photograph

6.1.2.3 Electronic Sample Logging

The sampling team may utilize field management software to prepare sample labels and chain-of-custody forms.

The following information should be entered for each sample after collection:

- Sample name
- Sample date and time
- Number of Sample bottles
- Type of Preservation
- Analyses
- Sampler's name(s)

In addition to these items, the software may also be used to keep track of other information such as sample depth, field measurements, and split samples.

6. Field Methods and Procedures

The field team will generate chain-of-custody forms for each cooler of samples packaged and sent to a laboratory. Each chain-of-custody form will refer to the shipping method and tracking number. Printed chain-of-custody forms will be submitted to the laboratory with the samples.

The use of field management software will require that the field team have access to a computer, a printer, computer paper, and labels while in the field. Field team members will have received specific training in use of the software.

6.1.3 Field Measurements

The following measurements will be made in the field during the sample collection effort.

6.1.3.1 Mapping Equipment

Sample points and Site features will be located and documented with a GPS unit. The GPS will be used to assign precise geographic coordinates to sample locations on the Site. GPS mapping will be done by personnel trained in the use of the equipment and will be completed in accordance with the manufacturer's instructions. Expected output from the use of GPS mapping will be Site maps with sample locations and major Site features.

6.2 Sediment Sampling Procedures

Sediment will be collected with an appropriate collection device, transferred to a laboratory supplied sample container, preserved, and shipped to the analytical laboratory for testing. Several sediment collection methods are described in this SAP. The actual sample collection method(s) will be selected based on field conditions.

Samples will typically be collected at or near high tide using a boat-mounted Vibracore system. The western-most samples will be collected first, as these areas are only inundated when tides exceed approximately 3 feet above mean sea level. Borings in Parcel F and those near the mouth of Yosemite Slough can be accessed more easily and are not as dependent on tide. At the completion of sampling each point, GPS coordinates for the sample location will be recorded.

All sample locations will be recorded in the field logbook as sampling is completed. A sketch, if needed, of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to reference points will be given.

Samples will be homogenized in a stainless steel bowl and then placed into the appropriate sample containers using stainless steel sampling scoops. Sample collection methods will depend on the method selected for borehole advancement. Samples will be placed in the appropriate container for each analysis method. All

6. Field Methods and Procedures

samples will be placed in coolers and chilled with ice to 4° C for storage and shipping to the analytical laboratory.

6.2.1 Collection Procedure for Sediment Sampling

Sediment samples will be collected in 1-foot intervals to a total depth of four feet below the mudline using one or more of the following methods:

- Hand auger with stainless steel sampling scoops used to homogenize and transfer the sample from the auger bucket to the appropriate sample container.
- Hand auger and slide hammer contamination: the boring will be hand augered to the desired depth, and a slide hammer will be used to advance a polyethylene, acetate, butyrate, or Teflon® tube to the desired sampling depth. The tube will be retrieved and the contents homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop.
- A gravity core (or similar) sampling device may be used to collect surface and near surface samples. The coring device will advance a polyethylene, acetate, butyrate, or Teflon® tube using gravity and a weight to the desired sampling depth. The tube will be retrieved and the contents homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop.
- A large diameter pipe may be used as a conductor casing to allow deeper sediment retrieval with a hand auger and to keep the borings open during sampling.
- Vibracore sampling technology may be used to retrieve sediment cores up to 20 feet bgs. The vibracore sampling device consists of a hollow casing attached to a vibrating motor, and a tripod and hoist are usually required for operation. The casing is advanced through the sediment using high frequency vibrations. The sediments liquefy and are collected in an inner liner made of butyrate or Teflon® within the hollow casing. The liner is then retrieved, and the cores may be homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop (GFA International 2009).

6.3 Field Decontamination Procedures

Decontamination activities will be conducted by the START in accordance with E & E SOP #3.15. All non-dedicated sample-handling devices will be decontaminated according to the following procedure:

1. Non-phosphate detergent and deionized or distilled water wash using a brush to scrub solids from the surface.
2. Double de-ionized or distilled water rinse.

6. Field Methods and Procedures

The sediment collection devices will be decontaminated by brushing out the excess sediment with coarse-hair brushes and wiping out with a paper towel. The device will then be washed in a bucket containing non-phosphate detergent and tap or de-ionized or distilled water. After the wash, the sampling device will be double rinsed with de-ionized or distilled water. Decontamination procedures for the sediment collection devices deviate from E & E SOP #3.15 due to the drying time that would be required for the sediment collection devices, and due to the use of non-phosphate detergent rather than acetone or methanol for decontamination.

7

Disposal of Investigation-Derived Waste

In the process of collecting environmental samples at this Site, several different types of potentially contaminated investigation-derived wastes (IDW) will be generated, including the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids and solids (e.g. cuttings and rinsate, etc.)

The U.S. EPA's National Contingency Plan required that management of IDW generated during Site investigations comply with all relevant or appropriate requirements to the extent practicable. This sampling plan will follow the Office of Emergency and Remedial Response Directive 9345.3-02 (May 1991), which provides the guidance for management of IDW during Site investigations. Listed below are the procedures that will be followed for handling IDW. The procedures are flexible enough to allow the Site investigation team to use its professional judgment on the proper method for the disposal of each type of IDW generated at each sampling location.

- Used PPE and disposable sampling equipment will be cleaned of loose sediment, then double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.
- Decontamination fluids will consist of water with residual contaminants and/or non-phosphate detergent. These fluids will be left at the Site in labeled, sealed 55-gallon drums until they are properly characterized for disposal.
- Drill cuttings, excess sample material, and other potentially contaminated solids will be left at the Site in labeled, sealed 55-gallon drums until they are properly characterized for disposal.

8

Sample Identification, Documentation, and Shipment

8.1 Sample Nomenclature

A unique, identifiable name will be assigned to each sample. Sampling locations for this field effort will begin with number 38, to remain consistent with the 2009 effort. Samples will again have a prefix “YC” indicating the Site from which they were collected (Yosemite Slough). The prefix will be followed by a number representing the sampling location, based on the order in which the samples were collected from that area. All samples will have a final one-digit integer indicating the approximate depth at which the sample was collected. This one digit integer will represent the deepest depth of a sample; for example, a sample collected from 3 to 4 feet below ground surface would be given the designation “4.” Field duplicate samples will have the same designations as their originals except the sequential number will be 800; thus, the field duplicate of YC-038-4 will be YC-838-4. For equipment rinsate blanks, the collection date will follow the “YC” designation, and the letters “RB” will be substituted for the depth suffix. A summary of this sample naming system is shown in Table 8-1.

8.2 Container, Preservation, and Holding Time Requirements

All sample containers will have been delivered to the START in a pre-cleaned condition. Container, preservation, and holding time requirements are summarized in Tables 5-1 and 5-2.

8.3 Sample Labeling, Packaging, and Shipping

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to the sample containers and will contain the following information:

- Sample name
- Date and time of collection
- Site name
- Analytical parameter and method of preservation

8. Sample Identification, Documentation, and Shipment

Table 8-1 Sample Numbering System

Location	Sample ID
Yosemite Slough Sediment Sample	YC-<sample location #>-depth ¹
<u>EXAMPLES</u>	
Sample Location 38, Surface Sample (0-1 feet bgs)	YC-038-1
Sample Location 45, Sample 3-4 feet bgs	YC-045-4
Field Duplicate	<Prefix>-<800 plus #>-depth
Equipment Rinsate Blank	YC-<sample date>-RB

Source: 2011 Ecology and Environment, Inc.

Notes:

¹ Use deepest sample depth achieved.

Samples will be stored in a secure location pending shipment to the laboratory. Sample coolers will be retained in the custody of Site personnel at all times or secured so as to deny access to anyone else. When samples are not under the direct control of the individual responsible for them, they will be stored in a locked container sealed with a custody seal.

The procedures for shipping sediment samples are:

- Ice will be packed in double zip-lock plastic bags.
- The drain plug of the cooler will be sealed with tape to prevent melting ice from leaking.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- Containers will have custody seals affixed so as to prevent opening of the container without breaking the seal.
- All glass sample containers will be wrapped in bubble wrap.
- All containers will be sealed in zip-lock plastic bags.

All samples will be placed in coolers with the appropriate chain-of-custody forms. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. Bags of ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap or styrofoam peanuts to prevent movement and breakage during shipment. Each ice chest will be securely taped

8. Sample Identification, Documentation, and Shipment

shut with strapping tape, and custody seals will be affixed to the front, right, and back of each cooler.

Samples will be shipped for immediate delivery to the contracted laboratory. Upon shipping, the laboratory will be notified of:

- Sampling contractor's name.
- Name of the Site.
- Shipment date and expected delivery date.
- Total number of samples, by matrix, and for each sample the relative level of contamination (i.e., low, medium, or high), if known.
- Carrier; air bill number(s), method of shipment (e.g., priority).
- Irregularities or anticipated problems associated with the samples.
- Whether additional samples will be sent; whether this is the last shipment.

8.4 Chain-of-Custody Forms and QA/QC Summary Forms

A chain-of-custody form will be maintained for all samples to be submitted for analysis, from the time the sample is collected until its final deposition. Every transfer of custody must be noted and a signature affixed. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake. When samples are not under the direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. The chain-of-custody form must include the following:

- Sample identification numbers
- Identification of sample to be used for Matrix Spike/Matrix Spike Duplicate (MS/MSD) purposes
- Site name
- Sample date
- Number and volume of sample containers
- Required analyses
- Signature and name of samplers
- Signature(s) of any individual(s) with control over samples
- Airbill number
- Note(s) indicating special holding times and/or detection limits



8. Sample Identification, Documentation, and Shipment

The chain-of-custody form will be completed and sent with the samples for each laboratory and each shipment. Each sample cooler will contain a chain-of-custody form for all samples within the sample cooler.

A QA/QC sample summary form will be completed for each method and each matrix of the sampling event. The sample number for all blanks, reference samples, laboratory QC samples (MS/MSDs), and duplicates will be documented on this form. This form is not sent to the laboratory. The original form will be sent to the reviewer who is validating and evaluating the data; a photocopy of the original will be made for the project manager's master file.

9

Quality Assurance and Quality Control

9.1 Field Quality Control Samples

The QA/QC samples described in the following subsections, which are also listed in Tables 5-1 and 5-2, will be collected during this investigation.

9.1.1 Equipment Blank Samples

An equipment rinsate blank will be collected to evaluate field sampling and decontamination procedures on the sediment sampling equipment during the course of fieldwork. Equipment rinsate blank samples will be collected at a rate of one per day of fieldwork.

9.1.2 Assessment of Sample Variability (Field Duplicate)

Duplicate split sediment samples will be collected at selected sample locations. These locations will be chosen in the field based on field observations and will be collected at a rate of 1 for every 10 field samples. A duplicate split sample is a 50/50 split of a sample after collection and homogenization.

9.1.3 Laboratory Quality Control Samples

A laboratory QC sample, also referred to as an MS/MSD, is not an extra sample; rather, it is a sample that requires additional QC analyses and therefore may require a larger sample volume. The chain-of-custody records for these samples will identify them as laboratory QC samples. The location of laboratory QC samples will be selected at random. At a minimum, one laboratory QC sample per 20 samples (or one per delivery group), per matrix, for each analytical parameter will be submitted. If the data quality indicators (DQIs) for analytical parameters are not achieved, further data review will be conducted to assess the impact on data quality. Laboratory QC samples, including laboratory MS/MSD and field duplicate samples, will be selected randomly.

Additional sample volume will be submitted for all samples designated as laboratory QC samples and will be marked on the chain-of-custody to the fixed-base laboratory.

9.2 Analytical and Data Package Requirements

It is required that all samples be analyzed in accordance with U.S. EPA Methods listed in Tables 5-1 and 5-2. The laboratory is required to supply documentation to demonstrate that their data meet the requirements specified in the method. Analytical laboratory turnaround time for sample results is approximately 20 days. The laboratory(ies) will also provide all data electronically in a spreadsheet-compatible format or delimited text file.

Deliverables for this project must meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (U.S. EPA Region IX R9/QA/00.4.1, March 2001). The following deliverables are required. Note that the following data requirements are included to specify and emphasize general documentation requirements and are not intended to supersede or change requirements of each method.

- A copy of the chain-of-custody, sample log-in records, and a case narrative describing the analyses and methods used.
- Analytical data (results) for up to three significant figures for all samples, method blanks, MS/MSD, Laboratory Control Samples (LCS), duplicates, Performance Evaluation (PE) samples, and field QC samples.
- QC summary sheets/forms that summarize the following:
 - MS/MSD/LCS recovery summary
 - Method/preparation blank summary
 - Initial and continuing calibration summary (including retention time windows)
 - Sample holding time and analytical sequence (i.e., extraction and analysis)
 - Calibration curves and correlation coefficients
 - Duplicate summary
 - Detection limit information
- Analyst bench records describing dilution, sample weight, percent moisture (solids), sample size, sample extraction and cleanup, final extract volumes, and amount injected.
- Standard preparation logs, including certificates of analysis for stock standards.
- Detailed explanation of the quantitation and identification procedure used for specific analyses, giving examples of calculations from the raw data.
- A final deliverable report consisting of sequentially numbered pages.
- Internal/surrogate recoveries.
- Gas Chromatograph/Mass Spectrometer tuning conditions.

9. Quality Assurance and Quality Control

- Reconstructed ion current chromatogram and quantitation reports for all sample standards, blanks, MS/MSD, and PE samples.
- For every compound identified and each field sample, provide raw versus enhanced spectra and enhanced versus reference spectra.
- For target analytes, the reference spectrum shall be the check standard for that sample. For tentatively identified compounds (TICs), the reference mass spectrum shall be the best fit spectrum from a search of the spectral library.
- Confirmation analysis data consisting of second column confirmation required for all TICs. Provide all associated raw data and summary sheets for the confirmation analyses.

9.3 Data Management

Samples will be collected and described in a logbook, as discussed in Section 6.1.2.1. Samples will be kept secure in the custody of the sampler at all times; the sampler will assure that all preservation parameters are being followed. All samples that are to be sent to the analytical laboratory will be collected and logged on chain-of-custody forms as discussed in Section 8.4. A START member will only submit samples to the analytical laboratory with chain-of-custody documentation. All submitted samples will be in properly custody-sealed containers. Specifics are discussed in Section 8.3. The laboratories will note any evidence of tampering upon receipt.

All data summary reports and complete data packages will be archived by the project manager and stored in the START project file. The data validation reports and laboratory data summary reports will be included in the final report to be submitted to the U.S. EPA and the START project file.

All field data including field measurements will be managed in SCRIBE.

9.4 Data Validation

Data validation of all data will be performed by the START or their subcontractor in accordance with U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1, December 2001.

Standard data quality review requirements, including Tier 2 data validation of 100 percent of the data (as defined in Documentation of Data Validation Requirements in Quality Assurance Project Plans, Field Sampling Plans, and SAPs, EPA Region IX Quality Assurance Office, January 2000), will satisfy the data quality requirements for this project. Upon completion of validation, data will be classified as one of the following: acceptable for use without qualifications, acceptable for use with qualifications, or unacceptable for use.

If during or after the evaluation of the project's analytical data it is found that the data contains excess QA/QC problems or if the data does not meet the DQI goals,

9. Quality Assurance and Quality Control

then the independent reviewer may determine that additional data evaluation is necessary. Additional evaluation may include U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1 for evaluation Tier 3.

To meet evaluation and project requirements, the following criteria will be evaluated during a Tier 2 evaluation:

Evaluation of Completeness

The data validator will verify that the laboratory sample information matches the field sampling information and that all the required items are included in the data package. If the data package is incomplete, the data validator will contact the laboratory, which must provide all missing information.

Evaluation of Compliance

The actual data validation effort will follow the following briefly outlined procedures:

- Review the data to check field and laboratory QC data, to verify that holding times and acceptance and performance criteria were met, and to note any anomalous values;
- Review chromatograms, mass spectra, and other raw data if provided as backup information for any apparent QC anomalies;
- Ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added;
- For any problems identified, review concerns with the laboratory, obtain additional information if necessary, and check all related data to determine the extent of the error; and
- Apply data qualifiers to the analytical results to indicate potential limitations on data usability.

The data validator will follow qualification guidelines stated in the START-3 procedures for Tier 2 Data Validation of ERS data.. This procedure follows guidelines derived from:

- *EPA CLP National Functional Guidelines for Organic Data Review*, (EPA 540/R-99-008, October 1999) or *EPA CLP National Functional Guidelines for Inorganic Data Review*, (EPA 540/R-94/013, February 1994).
- *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* (EPA/540/G-90/004, OSWER Directive 9360.4-01, dated April 1990).

9.5 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to this plan. When appropriate, the START QA Coordinator will be notified of the modifications and a verbal approval obtained before implementing the modifications. Modifications to the original plan will be recorded in Site records and documented in the final report.

9.6 Assessment of Project Activities

The following assessment activities will be performed by the START:

- All project deliverables (SAP, Data Summaries, Data Validation Reports, Investigation Report) will be peer reviewed prior to submission to the U.S. EPA. In time critical situations, the peer review may be concurrent with the release of a draft document to the U.S. EPA. Errors discovered in the peer review process will be reported by the reviewer to the originator of the document, who will be responsible for corrective action.
- The QA Coordinator will review project documentation (logbooks, chain-of-custody forms, etc.) to ensure the SAP was followed and that sampling activities were adequately documented. The QA Coordinator will document deficiencies, and the PM will be responsible for corrective actions.

9.6.1 Project Status Reports to Management

It is standard procedure for the START PM to report to the U.S. EPA any issues, as they occur, that arise during the course of the project which could affect data quality, data use objectives, the project objectives, or project schedules.

9.6.2 Reconciliation of Data with DQOs

Assessment of data quality is an ongoing activity throughout all phases of a project. The following outlines the methods to be used by the START for evaluating the results obtained from the project.

Review of the DQO outputs and the sampling design will be conducted by the START QA Coordinator prior to sampling activities. The reviewer will submit comments to the START PM for action, comment, or clarification. This process will be iterative.

A preliminary data review will be conducted by the START. The purpose of this review is to look for problems or anomalies in the implementation of the sample collection and analysis procedures and to examine QC data for information to verify assumptions underlying the DQOs and the SAP. When appropriate to sample design, basic statistical quantities will be calculated and the data will be graphically represented.



9. Quality Assurance and Quality Control

When appropriate to the sample design and if specifically tasked to do so by the U.S. EPA FOSC, the START will select a statistical hypothesis test and identify assumptions underlying the test.

10

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A

Data Quality Objectives

**Yosemite Slough EE/CA
Waste Characterization Study**

**Data Quality Objectives (DQO) Process Document
Objective Outputs**

**Contract: EP-S5-08-01
TDD No.: TO-07-09-11-10-0001
Job No.: 002693.7008.01SO**

In September 2012, the United States Environmental Protection Agency (U.S. EPA) Region IX Superfund Remedial Program Section directed the Ecology and Environment, Inc. Superfund Technical Assessment and Response Team (START) to support U.S. EPA's environmental data collection activities and a U.S. EPA-funded Engineering Evaluation and Cost Analysis (EE/CA) for a planned remediation of contaminated sediment in Yosemite Slough, San Francisco, San Francisco County, California. As part of the EE/CA process, it is necessary to estimate potential disposal costs that could be incurred during the future remedial action at Yosemite Slough. To help estimate these costs and support associated decision-making, the U.S. EPA tasked START to perform this Waste Characterization Study (WCS) of the impacted sediments at the Yosemite Slough Site. To support these activities, START has documented these project data quality objectives (DQOs) which will be used to develop the Yosemite Slough Waste Characterization Study Sampling and Analysis Plan (SAP). These DQOs will be included as Appendix A of the SAP.

1. THE PROBLEM

Background:

The Yosemite Slough Superfund Site (the Site) is an approximately 1,600-foot channel that receives sewage and stormwater system overflows and stormwater runoff and leads to the South Basin of the San Francisco Bay. In addition, the Site area may include a portion of the South Basin at the mouth of Yosemite Slough, within the area designated as Parcel F of the U.S. Navy's Hunters Point Shipyard (see Figures 1 and 2), where impacted sediments from multiple sources may have been, or are, commingled. The site is located at 37° 43' 25" north latitude, 122° 23' 07" west longitude. The Yosemite Slough drainage basin includes approximately 1,500 acres in southeastern San Francisco, California. Analytical data from previous and on-going investigations of multiple sites in the vicinity of the study area indicate slough sediments are contaminated with polychlorinated biphenyls (PCBs); metals including chromium, lead, mercury, and zinc; total petroleum hydrocarbons (TPH); and the pesticides chlordane, dieldrin, and dichloro-diphenyl-trichloroethane (DDT), all at concentrations exceeding appropriate screening levels.

Before 1900, the area around the site consisted primarily of wetlands, marshland, or land submerged below mean tide level. Between 1940 and 1970, much of the surrounding area was filled. The area surrounding the site was characterized by mixed residential, commercial, and industrial use beginning in the 1950s.

The San Francisco Public Utilities Commission (SFPUC) owned and operated the sewer system that has historically discharged to the site under various configurations. Between 1959 and approximately 1991, SFPUC's combined sewer system operated with three overflow structures (outfalls 40, 41, and 42) that

discharged to the site during wet weather events, which occurred 82 times per year on average. Outfall 41, which drained much of the area east of Highway 101, was located at the mouth of the site. Outfall 42 discharged at Fitch Street near the southern shoreline of the slough, draining areas that included industrial properties on the southern side of the site and Candlestick Park. Outfall 40 discharged near Griffith Street on the north side of the site and drained an area of approximately 200 acres, including Bay Area Drum.

In approximately 1991, SFPUC completed construction of overflow retention and storage basins for its combined sewer system. This upgrade has reduced the number of system overflows to the site to a long term average of one per year (Battelle 2004).

A summary of previous investigations at the site is presented in the Draft Final Sediment Investigation at Yosemite Slough report prepared by Battelle (2004). Sediments at the site were investigated in December 1995 under the Bay Protection and Toxic Cleanup Program. Samples contained concentrations of mercury and PCBs exceeding the effects range median (ERM) guidelines (Battelle 2004).

As a part of ongoing CERCLA remedial activities at Hunters Point Shipyard, a remedial investigation and feasibility study was performed at Parcel F, the portion of Hunters Point Shipyard that includes the South Basin shoreline and adjacent sediments, by PRC under the direction of the Navy in 1996. Sediment sample results in the South Basin and the site indicated elevated levels of mercury, PCBs, DDT, and chlordane (Battelle 2004).

Based on the evidence of contaminated sediments at the site, the San Francisco Bay Regional Water Quality Control Board required further investigation to delineate the nature and extent of contamination. Additional investigation and sampling of the site was performed under the direction of the San Francisco Public Utilities Commission (SFPUC) in October 1998, October 1999, and April 2000. The SFPUC investigation and sample results are discussed in the 2004 Battelle report, which states that the following contaminants of potential concern (COPCs) are present at the site at concentrations that exceeded their ERMs: lead, mercury, nickel, zinc, total PCBs, total DDT, total chlordane, and dieldrin. The maximum concentrations reported in surface sediments were: chromium at 202 parts per million (ppm), mercury at 1.21 ppm, nickel at 152 ppm, lead at 197 ppm, zinc at 316 ppm, PCBs at 1,317 parts per billion (ppb), total DDT at 142.1 ppb, total chlordane at 88.1 ppb, and dieldrin at 110.0 ppb. A total of 32 surface locations have been sampled by the SFPUC and the Navy in the vicinity of the site.

Subsurface samples were collected at five locations during the 2004 Battelle investigation. Subsurface samples were collected to total depths of 4 feet bgs in two locations, 3 feet bgs at one location, and 2 feet bgs at two locations. The maximum concentrations reported in subsurface sediments were: chromium at 368 ppm, lead at 811 ppm, mercury at 1.49 ppm, zinc at 830 ppm, dieldrin at 370 ppb, total chlordane at 208 ppb, total DDT at 1,430 ppb, and total PCBs at 2,356 ppb. These COPC concentrations exceeded their respective ERMs, with the exception of chromium, and generally appeared to decrease with depth.

As part of a removal assessment, START collected a total of 191 sediment samples from 36 sampling locations at Yosemite Slough from June 17 to July 9, 2009 to delineate the horizontal and vertical extent of contamination for the identified COPCs at the site (E&E 2011). Elevated COPCs were primarily observed in the upper four feet of sediment. PCBs, lead, mercury, zinc, and TPH-diesel concentrations exceeding site action levels were not completely delineated during removal assessment. Additionally, PCBs, lead, mercury, zinc, TPH-diesel, and TPH-motor oil were not defined in the downstream direction towards the entrance to San Francisco Bay and within Parcel F. Concentrations of Aroclor-1254 exceeded the ERM value of 180 µg/kg in almost all samples collected from surface to three feet bgs. Overall, Aroclor-1254 concentrations tended to decrease with increasing depth, although samples from many

boring locations exhibited an increase in concentrations from the 0 – 1 foot bgs interval to either the 1 – 2 feet bgs or 2 – 3 feet bgs intervals before decreasing in concentration at 3 feet bgs or deeper. Only a few borings had samples with maximum concentrations present at 4 or 5 feet bgs as opposed to shallower depths. The majority of the samples collected from 4 – 5 feet bgs did not contain Aroclor-1254 at concentrations exceeding the ERM value; but concentrations exceeding the ERM value were present near the downstream entrance to the Bay as well as in the upper half of the site. Maximum PCB concentrations detected as part of this effort exceeded regulatory guidance for waste disposal considerations, and therefore additional characterization is required. Subsequent to this investigation, both the U.S. EPA, U.S. Department of the Navy and a significant number of other responsible parties have been working toward the selection of an appropriate remedial option for the site, which has been determined to be affected by several source areas.

Because Yosemite Slough and the San Francisco Bay receive regional sediment which derives from naturally-occurring serpentinite deposits, waste disposal facilities occasionally require asbestos characterization prior to accepting waste. Therefore, asbestos analysis is included in the laboratory suite.

Conceptual Site Model:

- The media of concern is sediment at the site.
- The principal COPCs for waste disposal are asbestos total chromium, hexavalent chromium, lead, mercury, zinc, and PCBs.
- The sediment at the site was contaminated with COPCs from adjacent and nearby waste sites due to surface and stormwater runoff, groundwater, eroded sediment, wind-borne particulates, combined sewer overflows, and direct discharge of COPCs to the combined stormwater and sewer system.

Exposure Scenario:

Current Conditions

- Concerns based on current conditions include: 1) direct exposure of human and/or environmental receptors to COPCs in sediment, 2) exposure to San Francisco Bay water that contains elevated concentrations of COPCs, and 3) exposure to fish or other organisms such as plants and shellfish that may contain elevated levels of COPCs in their tissues due to bioaccumulation.

Remedial Action Conditions

- The conditions at the site during the remedial action may pose an additional threat to human health and the environment. Direct exposure of human and/or environmental receptors to COPC-contaminated sediment is of concern during remedial activities. The remedial action may disturb sediments causing them to become re-suspended in the water column, negatively affecting water quality and aquatic life.
- The sediment removed from the site may also pose a threat to human health during transportation and disposal.

Post Remedial

- No exposure scenarios are anticipated if contaminated sediment is removed from the site.

Planning Team:

Mr. Craig Cooper, U.S. EPA Remedial Project Manager (RPM)

Mr. Howard Edwards, START Quality Assurance Officer
Mr. Brian Milton, START Project Manager
Ms. Sara Dwight, START Field Team Leader
Analytical Laboratory – U.S. EPA Region IX lab, EPA Contract Laboratory Program (CLP) lab, or
START Basic Ordering Agreement (BOA) lab.

The Roles and Responsibilities for this Investigation are as Follows:

- **Craig Cooper, U.S. EPA RPM**, will be the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Additional duties include coordination of all preliminary and final reporting and communication with the START Project Manager.
- **Howard Edwards, START Quality Assurance Officer**, will provide quality assurance oversight to ensure that planning and plan implementation are in accordance with U.S. EPA regional quality assurance/quality control (QA/QC) protocol. He will provide technical direction concerning QA/QC as needed to the U.S. EPA FOSC and the START project manager.
- **Brian Milton, START Project Manager**, will coordinate with the planning team to develop objectives and complete an approved SAP. START will have the responsibility for implementation of the SAP, coordination of project tasks, coordination of field sampling, project management, and completion of all preliminary and final reporting.
- **Sara Dwight, START Field Team Leader**, will coordinate planning and execution of field tasks.

Available Resources:

The current START budget for environmental data collection activities and reporting is \$35,000 for activities related to the planning, sampling, data collection, evaluation, and reporting for this Yosemite Slough WCS. The analytical laboratories have not yet been selected. The budget for sample analysis at an analytical laboratory is to be determined.

Other Considerations and Constraints Related to Problem and Resources:

- The analytical laboratories have not been selected. The U.S. EPA Region IX lab, EPA CLP lab, or a START BOA lab will be used.
- Based upon the highest total reported concentration for dieldrin and chlordane the concentration in waste extraction samples are expected to be well below the hazardous waste criteria concentration. Based upon previous experience with this site, the detection and quantitation of both PCBs and organochlorine pesticide in the same matrix may be extremely difficult. Thus organochlorine pesticides (dieldrin, DDT, and chlordane) are not COPC for this investigation.
- Petroleum hydrocarbons are not COPC for this investigation, since the observed concentrations detected during the assessment investigation are unlikely to dictate where the waste can be disposed.
- Although it is possible to characterize the sediment collected as part of the current study for disposal purposes, it is likely that during the primary remedial effort, disposal facilities will require additional waste characterization sampling of sediment after it has been removed from Yosemite Slough and prior to disposal.
- It is likely that even if appropriate attempts are made to segregate wastes of varying characteristics (e.g. separating sediments with PCB concentrations above 50 ppm), mixing and homogenization will occur during the anticipated sediment dewatering phase. Therefore, estimates of the volume of each type of waste are likely to change, and estimates developed as part of the WCS and EE/CA

process may be overly conservative.

2. THE DECISION

Principal Study Questions:

Principal Study Question #1: Is there correlation between TCLP and WET extraction data and total COPC data.

Principal Study Question #2: Do the concentrations of COPCs in sediments at the site require disposal as TSCA, RCRA, or California Hazardous Waste?

Actions that could Result from Resolution of the Study Questions:

For Questions # 1:

Regardless of the correlation, the new set of data for samples collected for waste characterization will be used to extrapolate and estimate volumes and areas for various disposal alternatives. The correlation will only affect how the extrapolation and estimation will be done and the confidence in those estimations.

If it is resolved that there is good correlation between TCLP and WET extraction data and total COPC data, then the Engineering Estimate and Cost Analysis (EE/CA) will estimate volume and distribution assuming that there is good correlation. Previous sediment sampling results from the site will be assumed to correlate with extraction data and previous data will be used as a guide in planning the remedial action and for waste disposal. The data will also be used to make assumptions of volumes and areas of sediment that will require Class II Non-hazardous, California Hazardous, RCRA Characteristic, or TSCA-regulated disposal.

If it is resolved that there is poor correlation between TCLP and WET extraction data and total COPC data, then the Engineering Estimate and Cost Analysis (EE/CA) will estimate volume and distribution assuming that there is poor correlation. Previous sediment sampling results from the site will be assumed not to correlate with extraction data. The new data will be used as a guide in planning the remedial action and for waste disposal. The data will also be used to make assumptions of volumes and areas of sediment that will require Class II Non-hazardous, California Hazardous, RCRA Characteristic, or TSCA-regulated disposal.

For Question # 2:

If it is resolved that the concentrations of COPCs in sediments at areas within the site require disposal as TSCA, RCRA or California Hazardous Waste, then sediment in those areas will be assessed in the EE/CA using appropriate assumption for transportation and disposal..

If it is resolved that the concentrations of COPCs in sediments at areas within the site do not require disposal as TSCA, RCRA or California Hazardous Waste, then sediment will be assumed in the EE/CA to be able to be disposed of as Class II Non-hazardous.

Decision Statement(s):

For Question # 1: Determine and document whether a limited number of characterization samples can be used to extrapolate and estimate volumes and areas for various disposal alternatives in-order to determine whether additional sampling is necessary.

For Question # 2: Determine and document whether COPCs in sediments at the site require disposal as TSCA, RCRA, or California Hazardous Waste in-order to determine the appropriate waste disposal method in the EE/CA assessment.

3. DECISION INPUTS

Sources of Information Currently Available:

- *Sediment Investigation at Yosemite Creek* report by Arthur D. Little, Inc. 1999.
- *Sediment Investigation at Yosemite Creek* report by Battelle. 2004.
- *Yosemite Creek Sediment Removal Assessment Report, Final* report by E&E. May 2011.

New Environmental Data Required to Resolve the Decision Statements:

- Geospatial (location) data.
- COPC waste characterization data for sediments at the site.

Sources of Information to Resolve the Decision Statements:

- Global Positioning Service (GPS) location data from proposed sampling.
- Analytical data from proposed sampling.

Information Needed to Establish Waste Disposal Alternatives:

Action levels for COPCs will come from the following source:

- California Code of Regulations (CCR) at Title 22 Social Security, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste.
- CCR Regulations: Title 14, Natural Resources--Division 7, Chapter 3. Minimum Standards for Solid Waste Handling and Disposal
- U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Parts 260-299 (RCRA).
- CFR Protection of Environment, Parts 700-766, (TSCA).
- CFR Protection of Environment, Parts 239-259, (Solid Waste).

Measurement Methods:

Collected sediment samples can be definitely analyzed to determine COPC concentrations by several U.S. EPA methods as follows:

Metals

Inductively Coupled Argon Plasma-Emission Spectroscopy (ICP-ES), Inductively Coupled Argon Plasma-Mass Spectroscopy (ICP-MS), Atomic Absorption (AA), X-ray Fluorescence Spectrometry (XRF), and Ion Chromatography (IC). EPA methods include ICP-ES (6010), ICP-MS (6020), AA (7000 series).

PCBs

PCBs in sediment are typically analyzed by EPA 8082A Gas Chromatography/Electron Capture Detector (GC-ECD).

Waste Extractions

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." Toxicity characteristic leaching procedure (TCLP) and the California Assessment Manual (CAM) Waste Extraction Test (WET).

Hexavalent chromium

Several US EPA extraction and analysis methods exist for determination hexavalent chromium. The methods include: Coprecipitation method (US EPA Method 7195), a colorimetric method (US EPA Method 7196A), a chelation methods (US EPA Method 7197) and differential pulse polarography method

(US EPA
Method 7198.

Confirm that Appropriate (Analytical) Methods Exist to Provide the Necessary Data:

All indicated definitive methods have sufficient sensitivity, accuracy, precision, and other quality parameters to generate necessary data.

4. DEFINE THE STUDY BOUNDARIES

Specific Characteristics that Define Population Being Studied:

- The total concentrations of COPCs in sediment within the specified spatial and temporal boundaries.
- TCLP and WET extraction concentrations for metals will be determined should total metal concentrations exceed values indicated in table 5-1 (also see Figure 3 in the SAP).
- The correlation between characterization data for COPCs in sediment and previously collected data sets within the specified spatial and temporal boundaries.

Spatial Boundaries:

New characterization data will be generated from samples collected from the site. The investigation boundaries for the site will include the approximately 200-foot wide by 1,800-foot long area that makes up the Yosemite Slough channel and its mouth into the Bay. The boundary will encompass the specified area to a depth not to exceed five feet below the slough bottom, parts of which are exposed during low tide conditions.

Temporal Boundaries:

The decisions will apply to the extrapolation of characterization data to earlier data sets. Multiple stakeholders are involved in the evaluation of remedial scope and the EE/CA is time-sensitive. The timeframe of the planned remedial assessment and potential remedial action is as follows:

- SAP will be submitted to U.S. EPA by January 11, 2012.
- Sample collection will take place following SAP approval by the EPA.
- Sample volumes for the deepest sampling interval (5-feet) will be held by the laboratory pending preliminary results.
- Sample volumes for STLC and TCLP analysis will be held by the laboratory pending preliminary results. See table 7-1.
- All preliminary data will be reported to START and EPA within three weeks of sample delivery to the laboratory.
- Preliminary data on initial analyses will be used to make determinations regarding additional analyses of held volumes.
- Preliminary data on held volumes run will be reported to START and EPA within three weeks of authorization.
- All preliminary data will be used in a presentation for a stakeholders' meeting scheduled in February.
- Data packages and final data will be reported to START approximately five to seven weeks after sample delivery to the laboratory.
- Laboratory data will be validated following EPA Region IX Tier 1A guidance approximately four weeks after START receives the data from the laboratory.
- All project data will be used in the development of an EE/CA.

Practical Constraints on Data Collection:

Physical Constraints:

- Refusal in the subsurface will limit the vertical extent of sampling. Repeated sampling attempts at locations near refusal locations will proceed within practical time and effort constraints.
- It may be difficult to remove the sampling equipment from the sampling location at depth.

- Portions of the site are a tidal mud flat. Some sample locations can only be accessed at high tide using a boat-mounted vibracore direct-push drill rig.
- Samples submitted to the laboratory will be composites of the soil core collected between a discrete sampling interval.
- Water and/or soggy conditions may limit sampling access.
- Sampling equipment and/or personnel may become stuck in the sediment. Equipment may be damaged.
- Wind and/or waves on San Francisco Bay will prevent access to the site by boat.

Other Constraints on Data Collection

- The turnaround times on data are always estimated and cannot be assured. Sample and system problems may indiscriminately increase data turnaround times.
- Definitive data will undergo an EPA Region IX Tier 1A validation prior to final reporting.
- Additional time will be required if a determination of TCLP and STLC concentrations is needed.

5. DECISION RULE

Statistical Parameter:

One goal of the characterization sampling is to generate a geographically biased set of data points based on historical results. Each data point will be used to determine the contaminant concentration and waste characteristics at that location. The data points will be used to represent the geographic distribution of contamination.

Action Level:

COPC concentrations have already been determined to exceed screening levels. The data from this study will be compared to both state and Federal waste disposal guidelines to help establish disposal alternatives to be considered in the EE/CA.

Decision Rule:

If the characterization data indicate good correlation with existing data sets, then extrapolations regarding volumes and area can be made using previous sampling results. For example, if the characterization data indicate that sediments are regulated hazardous waste under TSCA, RCRA, or California rules, and there is good correlation between TTLC, TCLP and STLC data collected during the Waste Characterization Study, then it will be assumed that material with similar TTLC characteristics (as sampled during the E&E remedial assessment work) will be disposed of as a regulated hazardous waste, and extrapolations regarding volumes and areas can be made using previous sampling results.

If the correlation between TTLC and TCLP/STLC waste characterization data is poor, then assumptions about the relationship between new and existing data will be based on trends (if any) observed in data from the WCS. The observed trends will be used to make assumptions about existing data, volumes, and areas.

Table 5.1
Waste Characterization Criteria

Contaminants of Potential Concern	TCLP (mg/L)	STLC (mg/L)	TTLC (mg/kg)
Chromium (VI)	5.0	5.0	2,500
Lead	5.0	5.0	1,000
Zinc	NA	250	5,000
Mercury	0.2	0.2	20
Dieldrin	NA	0.8	8.0
Total DDT	NA	0.1	1.0
Chlordane	0.03	0.25	2.5
PCBs	NA	5.0	50
<p>TCLP = Toxicity Characteristic Leaching Procedure, 40 CFR Part 261. STLC = Soluble Threshold Limit Concentration, Title 26, California Code of Regulations TTLC = Total Threshold Limit Concentration, Title 26, California Code of Regulations mg/L = milligrams per liter mg/kg = milligrams per kilogram</p>			

6. LIMITS ON DECISION ERRORS

Range of the Parameter(s) of Interest:

For this investigation, the range of interest for COPCs is from the reporting limit up to ten times the regulatory limits for hazardous waste characteristics.

Quantitatively precise and accurate determination of waste characteristic criteria concentration above ten times the hazardous waste criteria concentration is not necessary.

Baseline Condition (*The Null Hypothesis*):

The contaminant concentrations in sediment are equal to or greater than the regulatory limits for hazardous waste characteristics.

Alternative Condition (*The Alternative Hypothesis*):

The contaminant concentrations in sediment are less than the regulatory limits for hazardous waste characteristics.

Decision Error

A discussion of decision error is presented in Table 6-1.

Decision Error Limits Goals

The decision error limits goals are stated in Table 6-2. The goal for the correlation coefficient between two data sets is a value that is greater than 0.70. A value of 0.70 will be considered as having acceptable correlation.

TABLE 6-1 DECISION ERROR Sediment		
<u>Decision Error</u>	Deciding that excavated sediment at the site is characteristic hazardous waste when it is not.	Deciding that excavated sediment at the site is not characteristic hazardous waste when it is.
<u>True Nature of Decision Error</u>	The hazardous waste characteristic data are either not representative or are biased high.	The hazardous waste characteristic data are either not representative or are biased low.
<u>The Consequence of Error</u>	Disposal options would cost additional resources including time, money, and manpower and could negatively impact the environment.	1) Disposal of excavated sediments would cost considerably more time, money, and manpower than the EE/CA estimate. 2) Rejection of excavated sediments transported to a disposal facility would likely cost the generator considerably more in resources including time, money, and manpower 3) Contaminated sediments disposed as non-haz waste could contaminate environmental media at an inappropriately constructed disposal facility.
<u>Which Decision Error Has More Severe Consequences near the action level?</u>	<u>LESS SEVERE</u> to human health, but with appreciable economic consequences.	<u>MORE SEVERE</u> because the contaminated soil may pose risks to human health and/or the environment at inappropriate disposal location and the potential for appreciable economic consequences.
<u>Error Type Based on Consequences</u>	<u>False Acceptance Decisions</u> A decision to dispose of sediment as hazardous waste when it is not.	<u>False Rejection Decisions</u> A decision to dispose of sediment as non-haz waste when it is haz waste.
<u>Definitions</u> False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false. False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true.		

TABLE 6-2 DECISION ERROR LIMIT GOALS Sediment			
True Average Concentration of Excavated Sediment (% of Action Level)	Decision Error	Typical Decision Error Probability Goals (Based on Professional Judgment)	Type of Decision Error
<75 %	A decision that excavated sediment at the site is characteristic hazardous waste when it is not.	less than 5 %	False Acceptance
75 to <100 % AL	A decision that excavated sediment at the site is characteristic hazardous waste when it is not.	Gray Area ¹	False Acceptance
100 to 150 % AL	A decision that excavated sediment at the site is not characteristic hazardous waste when it is.	10 %	False Rejection
> 150 %	A decision that excavated sediment at the site is not characteristic hazardous waste when it is.	less than 1%	False Rejection
The goals in this table are based on professional judgment as relevant to the Sediment Remedial Assessment.			
¹ Gray Area is where relatively large decision errors are acceptable.			

7. OPTIMIZED DESIGN FOR OBTAINING DATA

General:

All activities and documentation related to the project should proceed under a Quality Management Plan (QMP). All sampling, analytical and quality assurance activities will proceed under a U.S. EPA-approved SAP. A record of sampling activities and deviation from the SAP must be documented in a bound field log book. Prior to sample collection, all project sampling personnel will review relevant sampling procedures and relevant quality assurance and control (QA/QC) requirements for selected analytical methods.

Decision Error Minimization:

Average Concentrations

In order to minimize a decision error related to data uncertainty, the decision-maker should consider statistical evaluations of the data prior to making decisions.

Data from Individual Sample Locations

The decision-maker should consider data uncertainty when making decisions based upon sampling data and associated estimated values based upon a single location. An individual data value reported below the action level may potentially be biased low, while a data value reported above of the action level may potentially be biased high. The probability of decision errors increase at COPC concentrations around the action level due to both data uncertainty and data bias.

For any reported values near the method detection limit, the uncertainty of any given value is even greater. Thus the probability of decision error is greatly increased at COPC concentration near detection limits. The uncertainty for estimated data (i.e., data based on extrapolations and interpolations) is typically greater than for actual data. Therefore, the probability of decision errors is greatly increased for extrapolated data.

Due to the nature of the deposition of contamination, it is reasonable to assume that data from any individual sample locations on this site can represent a larger area. However, there are insufficient data to determine the confidence of any single sampling location. Thus the decision-maker should acknowledge that discrete data points could potentially not be representative of any greater area.

Contamination Distribution Map

Data from sampling locations can be used to create a contamination distribution map. The mapped contamination COPC concentration indicated within an area should generally be based upon the sample data from that area and the sample data from adjacent locations (particularly if discrete sample data is being used). The generated map model could be used to estimate the concentration of contamination throughout the property. The decision-maker should consider the data source and statistical sophistication of the distribution map prior to making decisions based upon the map.

Search Grid Size

Decision-makers should consider the sizes and probability of missing a contamination hot spot when evaluating sampling grid data.

Specific Design Optimization:

Based upon the project's goals and objectives, the Planning Team considered the following design elements as necessary to achieve DQOs:

- The collection and analysis of sediment samples for metals and PCBs.
- Generation of data that will indicate the geographical distribution of contamination (GPS data).

- Biased soil sampling over a predetermined area for the purpose of conservative extrapolation of characteristic data to previous sampling results.

Using Data Quality Objectives Decision Error Feasibility Trials Software (DEFT), the decision error limit values from step 6 and an estimation of the standard deviation of 40 percent of the action limit; the number of random samples needed to meet the objective is a total of 23 random samples.

To achieve the objectives, sediment from six to eight sampling locations will be sampled. At each location, four vertical samples per sampling location will be collected, for a total of 24 to 32 samples. To insure that the collected samples are at concentrations usable for establishing a correlation with historic data, the sampling locations will be selected based on previous analytical results in areas where there are documented contamination “hot spots”. The sediments in these areas are the most likely to have the hazardous waste characteristics needed to determine the correlation needed to support of the EE/CA evaluation in of remedial options.

Several methods of sediment sampling are possible at the site. Field conditions will determine which method(s) are used for this sampling event. Methods of sediment sampling may include:

- Hand auger with stainless steel sampling scoops used to homogenize and transfer the sample from the auger bucket to the appropriate sample container.
- Hand auger and slide hammer contamination: the boring will be hand augered to the desired depth, and a slide hammer will be used to advance a polyethylene, acetate, butyrate, or Teflon® tube to the desired sampling depth. The tube will be retrieved and the contents homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop.
- A gravity core (or similar) sampling device may be used to collect surface and near surface samples. The coring device will advance a polyethylene, acetate, butyrate, or Teflon® tube using gravity and a weight to the desired sampling depth. The tube will be retrieved and the contents homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop.
- It may be necessary to use a large diameter hollow PVC pipe to keep the borings open during sampling.
- Vibracore sampling technology may be used to retrieve sediment cores up to 20 feet bgs. The vibracore sampling device consists of a hollow casing attached to a vibrating motor, and a tripod and hoist are usually required for operation. The casing is advanced through the sediment using high frequency vibrations. The sediments liquefy and are collected in an inner liner made of butyrate or Teflon® within the hollow casing. The liner is then retrieved, and the cores may be homogenized and transferred to the appropriate sample containers using a stainless steel sampling scoop.

Samples will be collected at 1-foot intervals to a total depth of four feet. Four samples per location (0–1 feet bgs, 1–2 feet bgs, 2–3 feet bgs, and 3–4 feet bgs) will be collected. Samples will be homogenized in a stainless steel bowl and then placed into the appropriate sample containers using stainless steel sampling scoops. Sample collection methods will depend on the method selected for borehole advancement. Samples will be placed in the appropriate container for each analysis method. All samples will be placed in coolers and chilled with ice to 4° C for storage and shipping.

Samples will be collected by boat. Locations within Yosemite Slough will be accessible only at high tide.

Neither background nor reference soil samples will be collected. San Francisco Bay is known to contain similar COPCs, and there are no suitable upgradient reference areas beyond the site. Duplicates, equipment blanks, and other appropriate quality assurance/quality control samples should be collected and are

specified in the SAP. Data review, independent of the laboratory, should be performed on all analytical data that may be used in decision-making. The GPS coordinate (latitude and longitude) of each sampling location will be determined and documented during sampling.

If the initial sampling location is inaccessible or refusal is encountered, the boring will be moved several feet and a second attempt will be made. The field sampling team will proceed to collect samples at a specific location within practical time and effort constraints.

Analysis:

All sediment samples collected will be analyzed for COPCs by the following methods:

- EPA method 6010 for CAM-17 Metals (which will include Chromium, Lead, Mercury, and Zinc).
- EPA method 8082 for PCBs as Aroclors.
- Asbestos by Total PLM
- Hexavalent Chromium by EPA 7196A
- Additional sample volumes will be collected and held for California WET and TCLP extractions. The extract will be analyzed to determine STLC and TCLP concentrations based upon the samples total concentration as indicated in Table 7-1.

<p style="text-align: center;">Table 7.1 Extraction Criteria</p>			
Contaminants of Potential Concern	Total concentration requiring WET extraction	Total concentration requiring both TCLP and WET extractions	Total concentration requiring no extractions
Chromium (VI)	>50 mg/kg	>100 mg/kg	> 2,500 mg/kg
Lead	>50 mg/kg	>100 mg/kg	> 1,000 mg/kg
Zinc	> 2,500 mg/kg	Not Required	> 5,000 mg/kg
Mercury	2.0 mg/kg	4.0 mg/kg	> 20 mg/kg

B

Site Specific Health and Safety Plan

B. Site Specific Health & Safety Plan

The Site Specific Health & Safety Plan will be submitted under separate cover.



Standard Operating Procedures



Title:	SEDIMENT SAMPLING
Category:	ENV 3.8
Revised:	March 1998

STANDARD OPERATING PROCEDURE

SEDIMENT SAMPLING

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TITLE: SEDIMENT SAMPLING

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1. Introduction

This Standard Operating Procedure (SOP) describes the procedures for the collection of representative sediment samples. Analysis of sediment samples may determine whether concentrations of specific pollutants exceed established threshold action levels, and whether the concentrations of pollutants present a risk to public health, welfare, or the environment.

2. Scope

Included in this discussion are procedures for obtaining representative samples, quality assurance measures, proper documentation of sampling activities, and recommendations for personnel safety.

3. Method Summary

Sediment samples may be recovered using a variety of methods and equipment. These are dependent on 1) the depth of the water in which the samples will be collected; 2) the sediment's characteristics; 3) the volume of sediment required; and 4) the type of sample required (disturbed or undisturbed). Ultimately, the type of sampling device used should be consistent with the objective of the study.

Near-surface sediment samples may be collected using a scoop or spoon (if near shore or in shallow water), or sediment dredge or grab sampler (if in deeper water). To obtain other than surficial sediment samples, core samplers or split-spoon samplers are required.

All sampling devices should be cleaned using pesticide-grade acetone (assuming that acetone is not a target compound) or methanol, rinsed with distilled water, wrapped in aluminum foil, and custody sealed for identification. The sampling equipment should remain in this wrapping until needed. Each sampler should be used for one sample only. However, dedicated samplers may be impractical if there are a large number of sediment samples to be collected. In this case, samplers should be cleaned in the field using the decontamination procedures outlined in E & E's *Equipment Decontamination* SOP.



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4. Sample Preservation, Containers, Handling, and Storage

The chemical preservation of sediments is not generally recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time. Sediment samples should be handled according to standard techniques and project-specific requirements as detailed in project work/sampling plans and quality assurance project plans.

5. Potential Problems

Potential problems with sediment sampling include cross-contamination of samples and improper sample collection. Cross-contamination problems may be eliminated or minimized through the use of dedicated sampling equipment and bottles. If this is not possible or practical, then proper decontamination of sampling equipment is necessary. Improper sample collection can involve using inadequate or inappropriate sampling devices, contaminated equipment, disturbance of the matrix resulting in compaction of the sample, and inadequate homogenization of the sample where required, resulting in variable, nonrepresentative results.

6. Equipment

The following is a list of equipment and items typically used for sediment sampling:

- Sampling plan,
- Sample location map,
- Safety equipment, as specified in the health and safety plan,
- Compass,
- Survey equipment,
- Tape measure,
- Camera,
- Four-ounce and eight-ounce glass jars with teflon liners,



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- 40-ml glass vials with teflon-backed septum,
- Plastic bags for sample jars,
- Logbook,
- Labels,
- Waterproof ink pen,
- Chain-of-custody forms,
- Shipping cooler,
- Decontamination supplies and equipment, as described in the work plan,
- Canvas or plastic sheeting,
- Stainless-steel scoops,
- Stainless-steel spoons,
- Stainless-steel mixing bowls, or pans,
- Hand-driven split-spoon sampler,
- Shovel,
- Stainless-steel hand auger,
- Sediment dredge/grab sampler,
- Manual, gravity, or mechanical coring devices, and
- Teflon beaker attached to a telescoping pole.

7. Reagents

Sediment sampling does not require the use of reagents except for decontamination of equipment. Refer to E & E's *Equipment Decontamination* SOP and the site-specific work plan for proper decontamination procedures and appropriate solvents.



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8. Procedures

8.1 Office Preparation

- Prepare a sampling plan in accordance with contract requirements. Conduct a literature and information search and review available background information (e.g., topographic maps, soil survey maps, geological survey maps, other site reports, etc.) to determine the extent of the sampling effort, the sampling methods to be employed, and the type and amounts of equipment and supplies required.
- E & E corporate policy requires that a health and safety plan be prepared prior to commencing any sampling activity. The plan must be approved and signed by the corporate health and safety officer or his/her designee (e.g., the regional safety coordinator [RSC]).
- Obtain necessary sampling and monitoring equipment (see Section 6), and ensure that everything is in working order.
- Contact delivery service to confirm ability to ship all equipment and samples. Determine whether shipping restrictions exist.
- Prepare schedules and coordinate with staff, clients, property owners, and regulatory agencies, if appropriate.

8.2 Field Preparation

- Identify local suppliers of sampling expendables and overnight delivery services (e.g., Federal Express).
- Decontaminate or preclean all equipment before sediment sampling, as described in E & E's *Equipment Decontamination* SOP, or as deemed necessary.
- Calibrate all health & safety monitoring equipment daily.
- A general site survey should be performed prior to site entry, in accordance with the health and safety plan. A site safety meeting identifying physical and chemical hazards should be conducted prior to sampling activities.
- Identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All lo-



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cations must be cleared of utilities by the property owner or utility companies prior to sediment sampling.

8.3 Sample Collection

Numerous techniques and sampling devices may be employed to collect representative sediment samples. A number of sampling-related factors can contribute to the loss of sample integrity, including washout of fine-grained sediments during retrieval; compaction due to sample wall friction; and sampling vessel- or person-induced disturbance of surficial layers. Choosing the most appropriate sediment sampler for a study will depend on the sediment's characteristics, the volume and efficiency required, and the objectives of the study.

Most samples will be grab samples, although occasionally, sediment taken from various locations may be combined into one composite sample to reduce the amount of analytical support required.

The following procedure is used to collect surface sediment samples from small, low-flowing streams or near the shore of a pond or lake:

1. The sampler should select the sampling location furthest downstream for the first sample and work upstream. This will reduce the potential for disturbed sediments from migrating down to unsampled locations. This technique will also reduce the chances of cross-contaminating subsequent samples by sampling first in areas of suspected low contamination and working to the suspected higher concentration areas.
2. Using a precleaned, stainless-steel scoop, spoon, or other appropriate device, remove the required volume of sediment from the desired surface interval (e.g., 0-inch to 6-inch), place the sample in the appropriate precleaned glass jar, decant excess liquid as necessary, and secure the teflon-lined lid to the jar. If the sample is to be a composite sample, or if the sample is to be homogenized, the sediment is first placed in a stainless-steel mixing bowl and is homogenized prior to placement in the glass sample container. Samples for volatile organic analysis are not homogenized. Samples are handled in accordance with project-specific requirements.
3. Carefully and clearly identify the jar with the appropriate sample label, ensuring that all the categories or parameters listed in Section 10.1.1 have been addressed. Place a custody seal on the jar and lid, secure the seal in place with clear tape, and refrigerate the sample. The clear tape should also cover the jar's label.
4. Use the chain-of-custody form to document the types and number of sediment samples collected for shipment to a laboratory for analyses.



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5. In the field logbook record the time and date of sample collection, as well as a description of the sample and any associated air monitoring measurements.
6. Decontaminate sampling equipment in accordance with E & E's *Equipment Decontamination SOP*.

The following procedure is used to collect subsurface sediment samples from small, low-flowing streams or near the shore of a pond or lake:

1. The sampler should select the sampling location farthest downstream for the first sample and work upstream. This will reduce the potential for disturbed sediments from migrating downstream to unsampled locations, and will also reduce the chances of cross-contaminating subsequent samples.
2. Using a precleaned split-spoon sampler or other hollow coring device, drive the sampler to the required depth with a smooth continuous motion. Remove the coring device by rotating and lifting it in a single smooth motion until the sampler is free from the sediment.
3. Before the sediment sample can be removed from the sampling device, the overlying water must be removed from the sampler by slowly pouring or siphoning it off near one side of the sampler. Care should be taken to ensure that the sediments are not disturbed, and that the fine-grained surficial sediment and organic matter are not lost while removing the overlying water.
4. Disassemble the split-spoon sampler by placing pipe wrenches on either end of the sampler. Remove both ends and open the split spoon with a precleaned stainless-steel spoon. Recover the sediment core from a core tube by pushing the sample out with a precleaned stainless-steel spoon.
5. Collect the necessary sample by cutting the core with the handle of a precleaned stainless-steel spoon, placing the sample in the appropriate precleaned glass jar, and securing the teflon-lined lid to the jar. Samples are handled in accordance with project-specific requirements.
6. Carefully and clearly label the jar with the appropriate sample tag, ensuring that all of the categories or parameters listed in Section 10.1.1 have been addressed. Place a custody seal on the jar and lid, and secure the seal in place with clear tape.
7. Use the chain-of-custody form to document the types and number of sediment samples collected and logged.



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8. Record the time and date of sample collection, as well as a description of the sample and any associated air monitoring measurements, in the field logbook.
9. Decontaminate sampling equipment as per E & E's *Equipment Decontamination* SOP.

The following procedure is used to collect surface samples from rivers or from deeper lakes and ponds:

1. The sampler should select the sampling location farthest downstream for the first sample and work upstream. This will reduce the potential for disturbed sediments to migrate downstream to unsampled locations.
2. Using a precleaned sediment dredge or grab sampler, lower the sampler to the sediment layer with a polypropylene rope. Depending on the type of sampler used, the jaws of the sediment dredge will either automatically close, or will be triggered with a weighted messenger.
3. Recover the sampler and empty the sediment sample into a precleaned stainless-steel bowl. The water layer should be decanted slowly until only sediment remains in the bowl.
4. Using a precleaned stainless-steel spoon, remove the required volume of sediment. Place the sample in the appropriate precleaned glass jar, and secure the Teflon-lined lid to the jar.
5. Carefully and clearly identify the jar with the appropriate sample label, ensuring that all of the categories or parameters listed in Section 10.1.1 have been addressed. Place a custody seal on the jar and lid, and secure the seal in place with clear tape. The clear tape should cover the sample label.
6. Use the chain-of-custody form to document the types and number of sediment samples collected for shipment to a laboratory for analyses.
7. Record the time and date of sample collection, as well as a description of the sample and any associated air monitoring measurements, in the field logbook.
8. Decontaminate sampling equipment in accordance with E & E's *Equipment Decontamination* SOP.

The following procedure is used to collect subsurface samples from rivers or from deeper lakes and ponds:



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1. The sampler should select the sampling location farthest downstream for the first sample and work upstream. This will reduce the potential for disturbed sediments to migrate downstream to unsampled locations.
2. Attach a precleaned gravity or mechanical coring device to the required length of polypropylene sample line and allow the corer to freefall through the water to the bottom.
3. Determine the depth of sediment penetration, and if acceptable, retrieve the corer with a smooth, continuous lifting motion.
4. Remove the overlying water from the corer by slowly pouring or siphoning it off near one side of the sampler. Remove the nosepiece from the corer, and slide the sample out of the corer into a stainless-steel bowl or tray.
5. Collect the necessary sample by cutting the core with the handle of a stainless-steel spoon, placing the sample in the appropriate precleaned glass jar, and securing the teflon-lined lid to the jar. Samples are handled in accordance with project-specific requirements.
6. Carefully and clearly label the jar with the appropriate sample tag, ensuring that all of the categories or parameters listed in Section 10.1.1 have been addressed. Place a custody seal on the jar and lid, and secure the seal in place with clear tape.
7. Use the chain-of-custody form to document the types and number of sediment samples collected for shipment to a laboratory for analyses.
8. Record the time and date of sample collection, as well as a description of the sample and any associated air monitoring measurements, in the field logbook.
9. Decontaminate sampling equipment in accordance with E & E's *Equipment Decontamination SOP*.

8.4 Postoperations

1. Decontaminate all equipment according to E & E's *Equipment Decontamination SOP* prior to shipping the equipment back to the warehouse.
2. Organize field notes into the report format required by E & E's *Field Report Preparation SOP*. Logbooks should be maintained according to E & E's *Field Activities Log Book SOP*.



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3. All samples should be shipped on the same day that they were collected to arrive at the laboratory not more than 24 hours after the samples were collected in accordance with E & E's *Sample Packaging SOP*.

9. Calculations

There are no specific calculations required for sediment sampling.

10. Quality Assurance

10.1 Sample Documentation

10.1.1 Sediment Sample Label

All sediment samples shall be documented in accordance with standard labeling techniques and project-specific requirements. The sediment sample label is completed to the fullest possible extent, prior to collecting the sample, and should contain the following minimum information:

- Site name or identification;
- Sample location and identifier;
- Date sample was collected in a day, month, year format (e.g., 03 JUN 91 for June 3, 1991);
- Time of sample collection, using 24-hour clock in the hours: minutes format; and
- Analysis required.

10.1.2 Logbook

A bound field logbook will be maintained by field personnel to record daily activities in accordance with E & E's *Field Activities Logbooks SOP* and include sample collection, tracking, and shipping information. A separate entry will be made for each sample collected. These entries should include information from the sample label and a complete description of the location from which the sediment sample was collected.



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10.1.3 Chain-of-Custody

Use the chain-of-custody form to document the types and number of sediment samples collected and logged.

10.2 Sampling Plan Design

- Many of the activities critical to ensuring that the collected samples are of high quality take place in the pre-collection planning and preparation stage. Careful planning and attention to detail at this stage will result in a more successful sampling effort, and will ensure collection of the highest quality samples possible. Since site and sampling conditions vary widely, and no universal sampling procedure can be recommended, a detailed sampling plan, consistent with the objectives of the study, must be developed prior to any sampling activities.
- Any of the sampling methods described here should allow a representative sediment sample to be obtained if the sampling plan is properly designed.
- Consideration must also be given to the collection of a sample representative of all horizons present in the sediment. Selection of the proper sampling device will facilitate this procedure.
- A stringent quality assurance project plan (QAPP) should be outlined before any sampling operation is attempted. This should include, but not be limited to, the use of properly cleaned samplers and sample containers, chain-of-custody procedures, and collection of quality assurance samples such as field blanks, trip blanks, and duplicate samples.

11. Data Validation

The data generated will be reviewed according to quality assurance (QA) considerations identified in Section 10.

12. Health and Safety

Depending on site-specific contaminants, various protective programs must be implemented prior to sediment sampling. The site safety plan should be reviewed with specific em-



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phasis placed on a protection program planned for direct contact tasks. Standard safe operating practices should be followed, including minimizing contact with potential contaminants in both vapor and solid matrix by using both respirators and disposable clothing.

Use appropriate safe work practices for the type of contaminant expected (or determined from previous sampling efforts):

Particulate or Metals Contaminants

- Avoid skin contact with and incidental ingestion of dust. Wash hands and other exposed skin areas routinely.
- Use protective gloves when collecting and handling the sediment samples.

Volatile Organic Contaminants

- Hexane acts as a carrier for a number of semivolatile organic compounds. The presence of hexane vapors in the air while decontaminating samplers indicates that the potential for exposure exists.
- If monitoring results indicate the presence of organic vapors, sampling activities must be conducted in Level C protection.
- Acetone can penetrate some types of surgical gloves; use the appropriate gloves, such as Scorpio neoprene gloves, when handling acetone.

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STANDARD OPERATING PROCEDURE

SAMPLING EQUIPMENT DECONTAMINATION

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1. Scope and Application

The purpose of this procedure is to provide a description of methods for preventing or reducing cross-contamination and general guidelines for designing and selecting decontamination procedures for use at potential hazardous waste sites. The decontamination procedures chosen will prevent introduction and cross-contamination of suspected contaminants in environmental samples, and will protect the health and safety of site personnel.

2. Method Summary

Removing or neutralizing contaminants that have accumulated on personnel and equipment ensures protection of personnel from permeating substances, reduces/eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample contamination.

Cross-contamination can be removed by physical decontamination procedures. The abrasive and non-abrasive methods include the use of brushes, high pressure water, air and wet blasting, and high pressure Freon cleaning. These methods should be followed by a wash/rinse process using appropriate cleaning solutions. A general protocol for cleaning with solutions is as follows:

1. Physical removal.
2. Non-phosphate detergent plus tap water.
3. Tap water.
4. 10% nitric acid.
5. Distilled/deionized water rinse.
6. Solvent rinse.
7. Total air dry.
8. Triple rinse with distilled/deionized water.

This procedure can be expanded to include additional or alternate solvent rinses that will remove specified target compounds if required by site-specific work plans (WP) or as directed by a particular client.

3. Interferences

The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte-free distilled/deionized water. Distilled water available from local grocery stores and pharmacies is generally not acceptable for final decontamination rinses. Contaminant-free deionized water is available from commercial vendors and may be shipped directly to the site or your hotel.



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The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal water treatment system.

4. Equipment/Apparatus

The following are standard materials and equipment used as a part of the decontamination process:

- Appropriate protective clothing;
- Air purifying respirator (APR);
- Field log book;
- Non-phosphate detergent;
- Selected high purity, contaminant-free solvents;
- Long-handled brushes;
- Drop cloths (plastic sheeting);
- Trash containers;
- Paper towels;
- Galvanized tubs or equivalent (e.g., baby pools);
- Tap water;
- Contaminant-free distilled/deionized water;
- Metal/plastic container for storage and disposal of contaminated wash solutions;
- Pressurized sprayers, H₂O;
- Pressurized sprayers, solvents;
- Trash bags;
- Aluminum foil;
- Sample containers;



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- Safety glasses or splash shield; and
- Emergency eyewash bottle.

5. Reagents

There are no reagents used in this procedure aside from decontamination solutions used for the equipment. The type of decontamination solution to be used shall depend upon the type and degree of contamination present and as specified in the project/site-specific Quality Assurance Project Plan (QAPP).

In general, the following solvents are utilized for decontamination purposes:

- 10% nitric acid wash (reagent grade nitric acid diluted with deionized/distilled water – 1 part acid to 10 parts water)^a;
- Acetone (pesticide grade)^b ;
- Hexane (pesticide grade)^b;
- Methanol; and
- Methylene chloride^b.

^a Only if sample is to be analyzed for trace metals.

^b Only if sample is to be analyzed for organics requiring specific or specialized decontamination procedures. These solvents must be kept away from samples in order to avoid contamination by decon solvents.

6. Procedures

Decontamination is the process of removing or neutralizing contaminants that have accumulated on both personnel and equipment. Specific procedures in each case are designed accordingly and may be identified in either the Health and Safety Plan (HSP), WP, QAPP, or all three.

As part of the HSP, a personnel decontamination plan should be developed and set up before any personnel or equipment enters the areas of potential contamination. Decontamination procedures for equipment will be specified in the WP and the associated QAPP. These plans should include:

- Number and layout of decontamination stations;
- Decontamination equipment needed (see Section 4);



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- Appropriate decontamination methods;
- Procedures to prevent contamination of clean areas;
- Methods and procedures to minimize worker contact with contaminants during removal of protective clothing;
- Methods and procedures to prevent cross-contamination of samples and maintain sample integrity and sample custody; and
- Methods for disposal of contaminated clothing, equipment, and solutions.

Revisions to these plans may be necessary for health and safety when the types of protective clothing, site conditions, or on-site hazards are reassessed based on new information.

Prevention of Contamination

Several procedures can be established to minimize contact with waste and the potential for contamination. For example:

- Employing work practices that minimize contact with hazardous substances (e.g., avoid areas of obvious contamination, avoid touching potentially hazardous substances);
- Use of remote sampling, handling, and container-opening techniques;
- Covering monitoring and sampling equipment with plastic or other protective material;
- Use of disposable outer garments and disposable sampling equipment with proper containment of these disposable items;
- Use of disposable towels to clean the outer surfaces of sample bottles before and after sample collection; and
- Encasing the source of contaminants with plastic sheeting or overpacks.

Proper procedures for dressing prior to entrance into contaminated areas will minimize the potential for contaminants to bypass the protective clothing. Generally, all fasteners (zippers, buttons, snaps, etc.) should be used, gloves and boots tucked under or over sleeves and pant legs, and all junctures taped (see the Health and Safety Plan for these procedures).



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Decontamination Methods

All personnel, samples, and equipment leaving the contaminated area of a site must be decontaminated to remove any chemicals or infectious organisms that may have adhered to them. Various decontamination methods will either physically remove, inactivate by chemical detoxification/disinfection/sterilization, or remove contaminants by both physical and chemical means.

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques can be grouped into two categories: abrasive methods and non-abrasive methods.

6.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following reviews the available abrasive methods.

Mechanical

Mechanical methods include using brushes with metal, nylon, or natural bristles. The amount and type of contaminants removed will vary with the hardness of bristles, length of time brushing, and degree of brush contact. Material may also be removed by using appropriate tools to scrape, pry, or otherwise remove adhered materials.

Air Blasting

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, and time of air blasting dictate cleaning efficiency. The method's disadvantages are its inability to control the exact amount of material removed and its large amount of waste generated.

Wet Blasting

Wet blast cleaning involves the use of a suspended fine abrasive. The abrasive/water mixture is delivered by compressed air to the contaminated area. By using very fine abrasives, the amount of materials removed can be carefully controlled.

6.2 Non-abrasive Cleaning Methods

Non-abrasive cleaning methods work by either dissolution or by forcing the contaminant off a surface with pressure. In general, less of the equipment surface is removed using non-abrasive methods.



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High-Pressure Water

This method consists of a high-pressure pump, an operator controlled directional nozzle, and high-pressure hose. Operating pressure usually ranges from 340 to 680 psi, which relates to flow rates of 20 to 140 lpm.

Steam Cleaning

This method uses water delivered at high pressure and high temperature in order to remove accumulated solids and/or oils.

Ultra-High-Pressure Water

This system produces a water jet from 1,000 to 4,000 atm. This ultra-high-pressure spray can remove tightly-adhered surface films. The water velocity ranges from 500 m/sec. (1,000 atm) to 900 m/sec. (4,000 atm). Additives can be used to enhance the cleaning action, if approved by the QAPP for the project.

High-Pressure Freon Cleaning

Freon cleaning is a very effective method for cleaning cloth, rubber, plastic, and external/internal metal surfaces. Freon 113 (trichlorotrifluoroethane) is dense, chemically stable, relatively non-toxic, and leaves no residue. The vapor is easily removed from the air by activated charcoal. A high pressure (1,000 atm) jet of liquid Freon 113 is directed onto the surface to be cleaned. The Freon can be collected in a sump, filtered, and reused.

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. One or more of the following methods utilize cleaning solutions.

Dissolving

Removal of surface contaminants can be accomplished by chemically dissolving them, although the solvent must be compatible with the equipment and protective clothing. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products. Halogenated solvents are generally incompatible with protective clothing and are toxic. Table 1 provides a general guide to the solubility of contaminant categories in four types of solvents.

Surfactants

Surfactants reduce adhesion forces between contaminants and the surface being cleaned and prevents reposition of the contaminants. Non-phosphate detergents dissolved in tap water is an acceptable surfactant solution.



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Rinsing

Contaminants are removed and rinsing through dilution, physical attraction, and solubilization.

Disinfection/Sterilization

Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment and personal protective clothing.

6.3 Field Sampling Equipment Cleaning Procedures

The following steps for equipment cleaning should be followed for general field sampling activities.

1. Physical removal (abrasive or non-abrasive methods).
2. Scrub with non-phosphate detergent plus tap water.
3. Tap water rinse.
4. 10% nitric acid (required during sampling for inorganics only).
5. Distilled/deionized water rinse.
6. Solvent rinse (required during sampling for organics only).
7. Total air dry (required during sampling for organics only).
8. Triple rinse with distilled/deionized water.

Table 1 lists solvent rinses which may be required for elimination of particular chemicals. After each solvent rinse, the equipment should be air-dried and triple-rinsed with distilled/deionized water.

Solvent rinses are not necessarily required when organics are not a contaminant of concern. Similarly, an acid rinse is not necessarily required if analysis does not include inorganics.

NOTE: Reference the appropriate analytical procedure for specific decontamination solutions required for adequate removal of the contaminants of concern.

Sampling equipment that requires the use of plastic or teflon tubing should be disassembled, cleaned, and the tubing replaced with clean tubing, if necessary, before commencement of sampling or between sampling locations.



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Table 1 Decontamination Solvents

Solvent	Soluble Contaminants
Water	Low-chain compounds Salts Some organic acids and other polar compounds
Dilute Bases For example: <ul style="list-style-type: none">■ detergent■ soap	Acidic compounds Phenol Thiols Some nitro and sulfonic compounds
Organic Solvents: For example: <ul style="list-style-type: none">■ alcohols (methanol)■ ethers■ ketones■ aromatics■ straight-chain alkanes (e.g., hexane)■ common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)

WARNING: Some organic solvents can permeate and/or degrade the protective clothing.

7. Quality Assurance/Quality Control

QA/QC samples are intended to provide information concerning possible cross-contamination during collection, handling, preparation, and packing of samples from field locations for subsequent review and interpretation. A field blank (rinsate blank) provides an additional check on possible sources of contamination from ambient air and from sampling instruments used to collect and transfer samples into sample containers.

A field blank (rinsate blank) consists of a sample of analyte-free water passed through/over a precleaned/decontaminated sampling device and placed in a clean area to attempt to simulate a worst-case condition regarding ambient air contributions to sample contamination.

Field blanks should be collected at a rate of one per day per sample matrix even if samples are not shipped that day. The field blanks should return to the lab with the trip blanks originally sent to the field and be packed with their associated matrix.

The field blank places a mechanism of control on equipment decontamination, sample handling, storage, and shipment procedures. It is also indicative of ambient conditions and/or equipment conditions that may affect the quality of the samples.

Holding times for field blanks analyzed by CLP methods begin when the blank is received in the laboratory (as documented on the chain of parameters and associated analytical methods).

Holding times for samples and blanks analyzed by SW-846 or the 600 and 500 series begins at the time of sample collection.



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8. Health and Safety

Decontamination can pose hazards under certain circumstances even though performed to protect health and safety. Hazardous substances may be incompatible with decontamination methods (i.e., the method may react with contaminants to produce heat, explosion, or toxic products). Decontamination methods may be incompatible with clothing or equipment (e.g., some solvents can permeate and/or degrade protective clothing). Also, a direct health hazard to workers can be posed from chemical decontamination solutions that may be hazardous if inhaled or may be flammable.

The decontamination solutions must be determined to be compatible before use. Any method that permeates, degrades, or damages personal protective equipment should not be used. If decontamination methods do pose a direct health hazard, measures should be taken to protect personnel or modified to eliminate the hazard.

All site-specific safety procedures should be followed for the cleaning operation. At a minimum, the following precautions should be taken:

1. Safety glasses with splash shields or goggles, neoprene gloves, and laboratory apron should be worn.
2. All solvent rinsing operations should be conducted under a fume hood or in open air.
3. No eating, smoking, drinking, chewing, or any hand-to-mouth contact is permitted.

9. References

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, 1988.

A Compendium of Superfund Field Operations Methods, EPA 540/p-87/001.

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV, April 1, 1986.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October 1985.